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# The Application of Finance Theory to Increased Risk Harms in Toxic Tort Litigation

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THE APPLICATION OF FINANCE THEORY TO  
INCREASED RISK HARMS IN TOXIC  
TORT LITIGATION

*Robert J. Rhee\**

In toxic tort litigation, a plaintiff has no cause of action for increased risk of harm unless that risk is proven by a preponderance of the evidence to lead to a future physical injury. This rule of law is based on an antiquated concept of uncertainty, and it evinces the law's detachment both from other intellectual disciplines and from the everyday workings of the world. This article argues that freedom from increased risk should be a legally cognizable interest, the violation of which gives rise to an independent cause of action. When analyzed under finance theory, increased risk harms a person by increasing costs, reducing economic asset value and imposing a negative value option. The damage resulting from increased risk can be quantified by applying securities and derivatives pricing techniques used in the financial markets. This article further argues that the rules of liability and damages proposed here create the singular circumstance in law where the application of a statute of limitations would be a suboptimal solution for defendants. The statute of limitations imposes a barrier to informational efficiency for both parties. Accordingly, it should be eliminated in increased risk tort cases.

I. INTRODUCTION .....	112
II. RISK IN NONLEGAL CONTEXT .....	120
A. <i>The Value of Risk</i> .....	120
B. <i>Credit Valuation</i> .....	126

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	<i>C. Equity Valuation</i> .....	128
	<i>D. Option Valuation</i> .....	133
	<i>E. The Common Understanding</i> .....	138
III.	RISK IN THE LEGAL CONTEXT .....	139
	<i>A. The Traditional "All-or-Nothing" Rule</i> .....	139
	<i>B. The Loss of Chance Doctrine</i> .....	146
	<i>C. The Minority "Proportionality" Rule</i> .....	148
IV.	CRITICISM AND POLICY CONSIDERATIONS .....	151
	<i>A. The Legal Fiction of Injury and Causation</i> .....	151
	<i>B. Proportionality and Corrective Justice</i> .....	154
	<i>C. Statistical Justice and "Loading the Dice"</i> .....	163
	<i>D. Other Policy Considerations</i> .....	169
V.	FREEDOM FROM RISK AS A LEGAL INTEREST .....	172
	<i>A. Defining Interest and Harm</i> .....	172
	<i>B. Increased Risk as a Cost</i> .....	175
	<i>C. Increased Risk as a Diminution of Asset Value</i> ....	178
	<i>D. Increased Risk as a Negative Value Option</i> .....	181
	<i>E. Causation Revisited</i> .....	182
VI.	VALUING DAMAGES .....	184
	<i>A. Current Methods</i> .....	184
	<i>B. Option Pricing Model</i> .....	187
	<i>C. Economic Asset Model</i> .....	191
	<i>D. Comparison of Methods</i> .....	192
VII.	STATUTE OF LIMITATIONS .....	195
	<i>A. General Considerations</i> .....	195
	<i>B. Suboptimality</i> .....	196
VIII.	CONCLUSION .....	200

## I. INTRODUCTION

Traditional tort law is built on three great pillars of protected interests—body, property and money.<sup>1</sup> For each interest in this troika, the injury is tangible, results in harm in fact and damages can be readily valued. As the modern world speeds toward greater technological development and knowledge, the challenge of the law is to keep pace and to meet the demands of society.<sup>2</sup> Similar to the way technology and information drove the development of the

<sup>1</sup> See RESTATEMENT (SECOND) OF TORTS §§ 7 cmt. b, 924 (1965). Of course, there are other interests, such as invasion of privacy and defamation, but this troika represents the primary interests protected under tort law. See generally W. PAGE KEETON ET AL., PROSSER AND KEETON ON TORTS (5th ed. 1984) [hereinafter PROSSER & KEETON].

<sup>2</sup> The twentieth century has seen tort law become increasingly enmeshed in public policy. PROSSER & KEETON, *supra* note 1, § 3, at 15.

law of privacy,<sup>3</sup> modern society is learning of new harms that merit consideration of a remedy even though the interests involved defy easy categorization under the prevailing legal scheme.<sup>4</sup> Not so long ago, agents of harm took the form of things readily apparent, and causation and injury were routinely determined without serious dispute.<sup>5</sup> The old dangers still exist today, but the world has become more complicated, with the continued discovery of unseen or undetected agents of harm like toxins.<sup>6</sup> Moreover, progress in medicine and epidemiology have helped link these agents to resulting bodily harms.<sup>7</sup> Coinciding with these discoveries have been advances in mathematics and social sciences, such as statistics and financial economics, which have led to a better understanding of risk and risk management.<sup>8</sup> Nevertheless, courts have been slow to protect interests beyond the traditional injury troika because the current legal doctrines seem so inadequate to deal with new situations.<sup>9</sup> This reluctance dislocates the law from the needs and

<sup>3</sup> See Samuel Warren & Louis Brandeis, *The Right to Privacy*, 4 HARV. L. REV. 193, 195-96 (1890) (arguing that the advent of new technology and cultural phenomena, like photography and mass media, necessitates a right to privacy under tort law).

<sup>4</sup> See RESTATEMENT (SECOND) OF TORTS § 1 cmt. e (stating that the history of tort law has shown "a continuous tendency to recognize as worthy of legal protection interests which previously were not protected at all").

<sup>5</sup> See, e.g., *Allen v. United States*, 588 F. Supp. 247, 405 (D. Utah 1984) ("In most cases, the factual connection between defendant's conduct and plaintiff's injury is not genuinely in dispute. Often, the cause-and-effect relationship is obvious; A's vehicle strikes B, injuring him; a bottle of A's product explodes, injuring B; water impounded on A's property flows onto B's land, causing immediate damage."), *rev'd on other grounds*, 816 F.2d 1417 (10th Cir. 1987).

<sup>6</sup> Most increased risk cases arise in medical malpractice or toxic tort litigation. See, e.g., *Sterling v. Velsicol Chem. Corp.*, 855 F.2d 1188 (6th Cir. 1988) (toxic tort case); *Petriello v. Kalman*, 576 A.2d 474 (Conn. 1990) (medical malpractice case). Toxic tort involves harm to a person or property resulting from exposure to toxins. Recently, courts have seen an increase in cases involving increased risk harms without any physical manifestation. See Note, *Latent Harms and Risk-Based Damages*, 111 HARV. L. REV. 1505, 1506-07 (1998).

<sup>7</sup> Chief among these sciences is the study of epidemiology. See *infra* note 140; see generally Bert Black & David E. Lilienfeld, *Epidemiological Proof in Toxic Tort Litigation*, 52 FORDHAM L. REV. 732 (1984); Christopher Callahan, *Establishment of Causation in Toxic Tort Litigation*, 23 ARIZ. ST. L.J. 605 (1991).

<sup>8</sup> See *infra* Section II (discussing modern advances in the way financial economics treats risk).

<sup>9</sup> See *Ayers v. Jackson Township*, 525 A.2d 287, 299 (N.J. 1987) (noting that "common-law tort doctrines are ill-suited to the resolution of such injury claims"); Melanie Leslie, *Liability for Increased Risk of Harm: A Lawyer's Response to Professor Shafer*, 22 CARDOZO L. REV. 1835, 1837 (2001) (noting that traditional tort doctrine is "ill-equipped to deal with the uncertainties inherent in toxic tort cases"); see also Margaret Berger, *Eliminating General Causation: Notes Towards A New Theory of Justice and Toxic Torts*, 97 COLUM. L. REV. 2117, 2134 (1997) (noting that the causation element in toxic tort litigation "knocks out the link between culpability and liability"); Andrew R. Klein, *A Model for Enhanced Risk Recovery in Tort*, 56 WASH. & LEE L. REV. 1173, 1177 n.23 (1999) ("Such

expectations of society, and the law runs counter to the knowledge culled from other intellectual fields.<sup>10</sup> This conflict is manifested in cases of increased risk where a victim is exposed to an identifiable risk of harm but the physical injury is latent. Such cases involve two abstractions—risk<sup>11</sup> and time<sup>12</sup>—which pose a dilemma for a legal system that values certainty and predictability.<sup>13</sup>

Suppose a company negligently dumped carcinogens that leached into the local drinking water and the evidence shows that the plaintiff was exposed to a 25% to 30% increased risk of death at some point in the distant future.<sup>14</sup> Most people would recognize that the defendant's negligence put the plaintiff in a worse situation than she would be in without the culpable conduct.<sup>15</sup> The exposure increased her risk profile dramatically. Despite this com-

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'paradigms' might be viewed as revolving around physical, emotional, or economic harm. In enhanced risk cases, however, the plaintiff's injury simply cannot be so easily compartmentalized.").

<sup>10</sup> See David Rosenberg, *The Causal Connection in Mass Exposure Cases: A "Public Law" Vision of the Tort System*, 97 HARV. L. REV. 849, 926 (1984) (reluctance of courts to depart from traditional legal doctrine "may be a subtle admission of institutional incompetence" to deal with scientific and other technical knowledge). Cf. DAVID L. FAIGMAN, LABORATORY OF JUSTICE (2004) (discussing how courts have struggled to integrate scientific knowledge and discoveries into the legal framework).

<sup>11</sup> Risk is defined as "the possibility of loss, injury, disadvantage, or destruction . . . someone or something that creates or suggests a hazard or adverse chance . . . the degree of probability of such loss." WEBSTER'S THIRD NEW INTERNATIONAL DICTIONARY UNABRIDGED 1961 (1976). Obviously, without the law's hand, risk as a concept does not split into alternative universes of the "probable" and the "possible." The common usage and understanding is that risk exists across a spectrum.

<sup>12</sup> Long latency periods are problematic because tort law requires that injury and causation be confirmed in the present unless that injury can be shown to probably occur in the future.

<sup>13</sup> This need for certainty and predictability is seen in the doctrine of stare decisis, where past precedents serve as instruments of future predictability and certainty in the law. See *Thomas v. Wash. Gas Light Co.*, 448 U.S. 261, 272 (1980) ("[Stare decisis] not only plays an important role in orderly adjudication; it also serves the broader societal interests in evenhanded, consistent, and predictable application of legal rules."); Oona Hathaway, *Path Dependence in the Law: The Course and Pattern of Legal Change in a Common Law System*, 86 IOWA L. REV. 601, 651 (2001) ("[T]he use of precedent contributes to greater predictability and certainty in the law."); David Lyons, *Formal Justice and Judicial Precedent*, 38 VAND. L. REV. 495, 496 (1985) ("The reason most often given for the practice of precedent is that it increases the predictability of judicial decisions."). But see Nancy Levit, *Ethereal Torts*, 61 GEO. WASH. L. REV. 136, 137-38 (1992) (noting that the law has increasingly recognized uncertainty on both doctrinal and theoretical levels).

<sup>14</sup> These facts are from *Sterling v. Velsicol Chemical Corp.*, 855 F.2d 1188 (6th Cir. 1988), which is discussed at *infra* page 140-41 and accompanying notes.

<sup>15</sup> See, e.g., *Metro-North Commuters R.R. Co. v. Buckley*, 521 U.S. 424, 443 (1997) (holding that a plaintiff who had been exposed to asbestos "has suffered wrong at the hands of a negligent employer" but the wrong is not cognizable until there is a physical manifestation).

monsensical truth, courts have struggled to define the harm and causally connect the possibility of a future bodily injury to the defendant's conduct.<sup>16</sup> Tort law is built on the concept that there can be no cause of action without an injury that is causally connected to a defendant's wrongdoing.<sup>17</sup> Increased risk cases present a conflict between an intuitive (almost visceral) understanding of the plaintiff's misfortune and the traditional framework of accident law. Addressing these concerns, most courts have applied the traditional rule, often called the "all-or-nothing" rule, which states that if a plaintiff shows by a preponderance of the evidence that the increased risk will manifest into a physical injury, she can recover the present value of the damages for the future injury as if she currently suffers from it; otherwise she recovers nothing.<sup>18</sup>

Increased risk cases present unique challenges. Unlike most ordinary accidents where the proof is in the eye or the ear, physical injury and its causality are not past events requiring judicial reconstruction, but rather future events requiring judicial prediction.<sup>19</sup> One can only assess the probability of future injury and draw inferences from this assessment. In dealing with this abstraction, courts have clung to an antiquated concept of uncertainty that ignores the common expectation and the realities of modern society and markets. The problem stems from a fundamental misapprehension of the interest and harm at stake.<sup>20</sup> The interest, courts have assumed, is the freedom from personal injuries.<sup>21</sup> Under this rubric, the struggle has been to recognize an unmanifested bodily injury and to link that risk of harm to the defendant's conduct

<sup>16</sup> See, e.g., *Sterling*, 855 F.2d at 1188; *Anderson v. W.R. Grace & Co.*, 628 F. Supp. 1219 (D. Mass. 1986).

<sup>17</sup> The concepts of duty, breach, general and legal causation, and injury are standard fare in tort law. See Joseph King, "Reduction of Likelihood" *Reformation and Other Retrofitting of the Loss-of-a-Chance Doctrine*, 28 U. MEM. L. REV. 491, 497-99 (1998). But under some circumstances, traditional notions of causation are abolished, as is the case in the loss of chance cases and the market share theory of liability. See *infra* Section III.B (discussing loss of chance) and Section V.E (discussing market share liability).

<sup>18</sup> See *infra* Section III.A (discussing the traditional rule).

<sup>19</sup> See, e.g., *Hagerty v. L&L Marine Servs., Inc.*, 788 F.2d 315, 319 (5th Cir. 1986) (recovery only if plaintiff "can show that the toxic exposure more probably than not will lead to" injury), modified on other grounds, 797 F.2d 256 (5th Cir. 1986).

<sup>20</sup> Harm is a detriment in fact and is different from an injury, which is the invasion of a legally protected interest. RESTATEMENT (SECOND) OF TORTS § 7(1) cmt. a (1965); see also *infra* Section V.A (discussing harm and injury).

<sup>21</sup> See, e.g., *Pietrzak v. Eggen*, 295 N.W.2d 504, 507 (Minn. 1980) ("[T]he plaintiff is entitled to an instruction on future damages if he or she has shown that such damage is more likely to occur than not to occur."); *Mauro v. Raymark Indus., Inc.*, 561 A.2d 257, 264 (N.J. 1989) ("[P]laintiff must prove that the prospective disease is at least reasonably probable to occur.").

under a causation analysis. The glue connecting these elements is the preponderance of the evidence standard, which separates the "probable" (deemed a legal certainty) from the "possible" (deemed mere speculation).<sup>22</sup>

The law treats risk not as a spectrum of information on adverse chance but as a formalistic dichotomy that supposedly proves injury-in-fact and causation. Yet the traditional analysis does not prove causation and injury as perceived by the law, which in fact have not occurred; instead it creates the legal fiction of injury and so causation as well.<sup>23</sup> Many scholars have criticized the traditional rule, and their arguments have primarily focused on various policy considerations: the unfairness and arbitrariness of the rule,<sup>24</sup> the under-deterrence of harmful conduct and related social utility concerns,<sup>25</sup> the under-compensation of plaintiffs,<sup>26</sup> the violation of a victim's autonomy<sup>27</sup> and the "moral responsibility" of defendants.<sup>28</sup> Based on these considerations, various solutions to the increased

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<sup>22</sup> See *infra* text accompanying notes 137-148 (discussing evidentiary hurdles imposed by the traditional tort doctrines).

<sup>23</sup> See *infra* Section IV.A.

<sup>24</sup> See, e.g., 2 J. NATES ET AL., DAMAGES IN TORT ACTIONS § 13.02 (2001) ("The primary motivation of the courts for permitting damages for such an injury is fairness."); Richard Delgado, *Beyond Sindell: Relaxation of Cause-in-Fact Rules of Indeterminate Plaintiffs*, 70 CAL. L. REV. 881, 893 (1982) (advocating fairness of proportional recovery because "there is neither over- nor under-deterrence"); Joseph H. King, Jr., *Causation, Valuation, and Chance in Personal Injury Torts Involving Preexisting Conditions and Future Consequences*, 90 YALE L.J. 1370, 1376 (1981) (arguing that the traditional rule is "arbitrary").

<sup>25</sup> See, e.g., WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF TORT LAW 263-68 (1987) (proposing the social utility function of tort law); Neil Orloff & Jerry Stedinger, *A Framework for Evaluating the Preponderance-of-the-Evidence Standard*, 131 U. PA. L. REV. 1159, 1169 (1983) ("While some plaintiffs are under-compensated and others are over-compensated, they received, as a group, exactly the amount to which they are entitled."); Glen O. Robinson, *Probabilistic Causation and Compensation for Tortious Risk*, 14 J. LEGAL STUD. 779, 783-89 (1985) ("In the utilitarian model the essential function of a tort system is efficient risk management in order to reduce the net social costs of accidents, that is, the excess of accident-related costs over activity-related benefits.").

<sup>26</sup> See, e.g., 2 JACOB A. STEIN, STEIN ON PERSONAL INJURY DAMAGES § 9:16 (Gerald W. Boston ed., 3d ed. 1997) ("Compensation should be given for the fact of increased susceptibility to the illness."); Rosenberg, *supra* note 10, at 881 (proportionality rule preserves the "value of entitlements"); Christopher H. Schroeder, *Corrective Justice and Liability for Increasing Risk*, 37 UCLA L. REV. 439, 466-69 (1990) (proportionality rule meets need to compensate victims across broader class).

<sup>27</sup> See, e.g., E. Donald Elliott, *The Future of Toxic Torts: Of Chemophobia, Risk as a Compensable Injury and Hybrid Compensation Systems*, 25 Hous. L. REV. 781, 789 (1988) (proposing the elimination of traditional doctrines because "violation of a person's bodily autonomy . . . is also an injury that the law should recognize and compensate").

<sup>28</sup> See, e.g., Berger, *supra* note 9, at 2131-34 (arguing that companies have moral responsibility to remedy injuries caused).

risk problem have been proposed.<sup>29</sup> This article builds on some of these arguments, particularly with respect to the logical and legal inconsistencies of the traditional approach.<sup>30</sup> But the primary purpose of this article is not to criticize the traditional rule on policy grounds; that has been ably done by others.<sup>31</sup> Rather, its purpose is to show that based on an application of finance theory, increased risk is itself both a harm and an injury.<sup>32</sup> Here too the suggestion has been made,<sup>33</sup> but thus far there has not been an adequate

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<sup>29</sup> See *id.* at 2152 (arguing for the elimination of the causation element); E. Donald Elliott, *Why Courts? Comment on Robinson*, 14 J. LEGAL STUD. 799, 801 (1985) (proposing legislative remedial solutions); King, *supra* note 24, at 1382 (proposing a proportional scheme of recovery); Klein, *supra* note 9, at 1210 (adopting rule of recovery but only if the relative risk is at least doubled); Robinson, *supra* note 25, at 787 (advocating damages calculated as "equal to the present value of future losses multiplied by the estimated probability of their occurrence"); Rosenberg, *supra* note 10, at 908-10 (proposing proportional recovery scheme under a "public law" approach in which class actions deal with mass exposures); Glenn Shafer, *Causality and Responsibility*, 22 CARDOZO L. REV. 1811, 1832-34 (2001) (proposing class actions to proportionally distribute remedies). But see John C.P. Goldberg & Benjamin C. Zipursky, *Unrealized Torts*, 88 VA. L. REV. 1625, 1650-60 (2002) (arguing that probabilistic injuries are unrealized harms and thus not cognizable injuries); Jonathan C. Mosher, *A Pound of Cause for a Penny of Proof: The Failed Economy of an Eroded Causation Standard in Toxic Tort Cases*, 11 N.Y.U. ENVTL. L.J. 531 (2003) (arguing against the erosion of traditional causation standards in toxic tort litigation); Richard W. Wright, *The Efficiency Theory of Causation and Responsibility: Unscientific Formalism and False Semantics*, 63 CHI.-KENT L. REV. 553, 578 (1987) (advocating adherence to traditional concept of causation).

The topic of increased risk has also been a favorite topic for student scholars. See, e.g., Gregory L. Ash, Comment, *Toxic Torts and Latent Diseases: The Case for an Increased Risk Cause of Action*, 38 U. KAN. L. REV. 1087 (1990); David Ashton, Comment, *Decreasing the Risks Inherent in Claims for Increased Risk of Future Disease*, 43 U. MIAMI L. REV. 1081, 1103-05 (1989); Kira Elert, Note, *Dillon v. Evanston Hospital: Illinois Adopts the New Increased Risk Doctrine Governing Recovery for Future Injury*, 34 LOY. U. CHI. L.J. 685, 691 (2003); Keith Lapeze, Comment, *Recovery for Increased Risk of Disease in Louisiana*, 58 LA. L. REV. 249, 254 n.35 (1997); Barton Legum, Note, *Increased Risk of Cancer as an Actionable Injury*, 18 GA. L. REV. 563, 568 (1984); Tamsen O. Love, Note, *Detering Irresponsible Use and Disposal of Toxic Substances: The Case for Legislative Recognition of Increased Risk Causes of Action*, 49 VAND. L. REV. 789 (1996); Deirdre A. McDonnell, Comment, *Increased Risk of Disease Damages: Proportional Recovery as an Alternative to the All or Nothing System Exemplified by Asbestos Cases*, 24 B.C. ENVTL. AFF. L. REV. 623, 647-48 (1997); Diane Schmauder, Note, *An Analysis of New Jersey's Increased Risk Doctrine*, 25 RUTGERS L.J. 893, 926-31 (1994).

<sup>30</sup> See *infra* Section III.A (discussing the policy concerns surrounding the traditional rule and the proportionality approach). This article agrees that a proportionality approach, *in general*, is a superior method in increased risk torts. But it proposes that the damage calculation method under the proportionality rule is also flawed and could lead to significant overcompensation of the victims. See *infra* Section VI.A.

<sup>31</sup> See *supra* notes 24-29.

<sup>32</sup> See *infra* Section V.A (discussing the harms suffered by exposed victims).

<sup>33</sup> See Elert, *supra* note 29, at 696 ("[A] court should focus upon whether a defendant caused an increased risk itself."); Christopher H. Schroeder, *Corrective Justice, Liability for Risks, and Tort Law*, 38 UCLA L. REV. 143, 160 (1990) ("In other words, is the risk of



explanation outside of an ex post justification that legal recognition of risk as an injury is necessary to legitimize the broad array of policy considerations.

Increased risk does not fit squarely into the traditional paradigm of injury,<sup>34</sup> and so has been characterized as a "nuncognizable" or unrealized injury of an inchoate nature.<sup>35</sup> Such characterizations are made from a physical point of reference, and arguments based on that perspective lead to but one conclusion. Rather than being explanatory, these characterizations merely beg the question and underscore the struggle to articulate this new interest within the conventional language of tort interests.<sup>36</sup> The interest here involves a hybrid tort, sharing traits of a negligence action for bodily injuries and an informational tort like invasion of privacy or defamation. In one sense, it is a contingent claim for personal injury; in another sense, it is a claim for economic damages to the victim's future earning stream, which is a capital asset akin to a property interest; and yet it is also information concerning adverse uncertainty that is the true harm. Although an accident precipitates the cause of action, the essential nature and character of the injury defies convenient or conventional classification. An interdisciplinary analysis can link these seemingly disparate characterizations into a better understanding of the interest and injury at stake.<sup>37</sup>

The recognition of a new legal interest involves several considerations. This article addresses the following questions. Is increased

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harm itself a harm? The answer may be yes, but less obviously than in case of physical injury."); Schroeder, *supra* note 26, at 442 (arguing that increased risk is harm that should be recoverable under corrective justice theory).

<sup>34</sup> See *Cottle v. Superior Court*, 5 Cal. Rptr. 2d 882, 903 (Ct. App. 1992) (Johnson, J., dissenting) ("The old rules of causation simply don't work—because toxics are not automobiles or the other instruments of sudden destruction so familiar to the law."); Love, *supra* note 29, at 805 ("Courts typically try to force these causes of action into the traditional tort paradigm, with the result that plaintiffs are faced with difficult and often insurmountable barriers to recovery.").

<sup>35</sup> See PROSSER & KEETON, *supra* note 1, § 30, at 165 ("The threat of future harm, not yet realized, is not enough."); Goldberg & Zipursky, *supra* note 29, at 1634 ("[Heightened risk] is, at most, a nuncognizable harm—a harm but not an injury . . .").

<sup>36</sup> See *Schweitzer v. Consol. Rail Corp.*, 758 F.2d 936, 942 (3d Cir. 1985) ("It is obvious that proof of damages in such cases would be highly speculative, likely resulting in windfalls for those who never take ill and insufficient compensation for those who do. Requiring manifest injury as a necessary element of an asbestos related tort action avoids these problems and best serves the underlying purpose of tort law: the compensation of victims who have suffered.").

<sup>37</sup> Daniel Farber, *Recurring Misses*, 19 J. LEGAL STUD. 727, 737 (1990) (observing that legal scholarship in this matter has tended to separate rules of liability, evidence and damage, and this compartmentalization has created intellectual inertia that has hindered analysis).

risk a harm? If so, what is the nature of that harm? Is there a societal expectation of compensation? Are there policy reasons militating for or against such an interest? How should damages be calculated? How should such an independent cause of action be administered procedurally? Unless these questions are answered, the debate will continue to revolve around policy grounds, the persuasiveness of which, however eloquent, is limited when the alternative is to throw out hallowed principles of tort law such as causation and injury.

Section II discusses the way financial economics and modern markets treat risk, and how risk affects the pricing of securities, the valuation of firms, and the decisions of firms, governments and individuals. The purpose of this section is to put the forthcoming legal discussion of risk in the broader context of social expectations, the ordinary workings of the world order outside of the law, and an interdisciplinary understanding.

Section III discusses the doctrines of increased risk and loss of chance. For such a controversial field, courts have been consistent in fashioning substantive rules dealing with risk and latent injuries. This section also discusses the administrative problems of applying a statute of limitations and *res judicata* to latent injuries.

Section IV discusses the various criticisms levied against the traditional approach. It shows that a proportionality scheme, in principle, is more consistent with the goals of tort law and provides a more accurate allocation of remedy and deterrence.

Section V discusses the nature of the harm caused by increased risk from the perspective of finance theory. This discussion will build on the financial concepts discussed in Section II. Increased risk changes the essential nature and character of the victim. In this light, a victim can be analogized to a financial instrument, and securities pricing techniques can be used to measure the harm.

Section VI proposes two alternative methods to calculate damages: economic asset valuation and option pricing theory. Under both the traditional and proportionality schemes, a potential for significant overcompensation exists because both methods are static calculations. Finance theory presupposes the dynamic nature of risk and time, which cannot be ignored in the valuation of uncertainty.

Section VII discusses statutes of limitations. A statute of limitations always favors the defendant. But when the rules of law proposed by this article are applied, it creates the singular circumstance where the imposition of a statute of limitations is

suboptimal for defendants. Accordingly, this article proposes the elimination of statutes of limitations for increased risk cases on efficiency grounds.

## II. RISK IN NONLEGAL CONTEXT

### A. *The Value of Risk*

The problems posed by risk are not unique to the law. Uncertainty is as ubiquitous as the air we breathe.<sup>38</sup> While the law has searched for order and predictability in the complexities of human interactions, the intellectual understanding of risk has been greatly advanced by fields outside of the law such as statistics, epidemiology, insurance and financial economics.<sup>39</sup> These disciplines seek to understand and manage uncertainty in the context of their respective fields. Financial economics is the study of risk in the context of investments and finance, and this article uses its principles to bridge the gap between the social costs of uncertainty and the framework of tort law.

If the first order principle of Anglo-American jurisprudence is the notion of fundamental fairness,<sup>40</sup> then its equivalent in financial economics is that risk has value. If this were not the case, financial markets would not exist—nor would insurance, banking, credit cards, mortgages, consumer warranties or lotteries. The modern world assigns value to risk; it assesses, trades, buys and sells risk—not in the speculative manner of a prodigal gambler—but in the rational choices of individuals, firms and governments. This understanding was not always the case, however. As Bernstein astutely observed:

The revolutionary idea that defines the boundary between modern times and the past is the mastery of risk: the notion that the future is more than a whim of the gods and that men and women are not passive before nature. Until human beings discovered a way across that boundary, the future was a mirror of the past or the murky domain of ora-

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<sup>38</sup> The law has long recognized the problem of "negligence in the air." *Palsgraf v. Long Island R.R. Co.*, 162 N.E. 99, 102 (N.Y. 1928) (Cardozo, J.).

<sup>39</sup> Statistics is the branch of mathematics that deals with probabilities and relationships among numbers. Epidemiology is the science of disease distribution and causes among human populations, and uses statistical inferences to show relationships between illnesses and cause. See *infra* note 140; see generally Michael Dore, *A Commentary on the Use of Epidemiological Evidence in Demonstrating Cause-in-Fact*, 7 HARV. ENVTL. L. REV. 429, 431-33 (1983).

<sup>40</sup> See *Moran v. Ohio*, 469 U.S. 948, 955 (1984) (noting that "notions of fundamental fairness . . . are at the heart of Anglo-American law").

cles and soothsayers who held a monopoly over knowledge of anticipated events.<sup>41</sup>

Like many of the technological and informational breakthroughs of the twentieth century, financial economics has had a revolutionary impact on industry and society.<sup>42</sup> Only recently could financial risk be calculated in a quantitatively rational manner rather than be assessed with intuition or a certain gambling spirit.<sup>43</sup> While there have been many noteworthy contributions to finance theory in the past fifty years, this article focuses on three theories that illustrate the concept of the value of risk: the Efficient Portfolio Theory, the Capital Asset Pricing Model, and the Black-Scholes Option Pricing Model. These theories were chosen because their underlying principles are relevant to this article's discussion of increased risk torts, the nature of litigation risk, and some of the key ideas on damage calculation.<sup>44</sup>

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<sup>41</sup> PETER BERNSTEIN, *AGAINST THE GODS: THE REMARKABLE STORY OF RISK* 1 (1996). The subject of risk has occupied the thoughts of the great economic thinkers. For instance, Adam Smith characterized the "universal" tendency for humans to speculate as an "overweening conceit." ADAM SMITH, *AN INQUIRY INTO THE NATURE AND CAUSES OF THE WEALTH OF NATIONS*, bk. I, ch. X, at 124 (Edwin Cannan ed., Modern Library 1994). Yet John Maynard Keynes observed that a certain risk-taking spirit is a prime catalyst for capitalism:

Thus if the animal spirits are dimmed and the spontaneous optimism falters, leaving us to depend on nothing but a mathematical expectation, enterprise will fade and die;—though fears of loss may have a basis no more reasonable than hopes of profit had before. . . . [I]t is our innate urge to activity which makes the wheels go round, our rational selves choosing between the alternatives as best we are able, calculating where we can, but often falling back for our motive on whim or sentiment or chance.

JOHN MAYNARD KEYNES, *THE GENERAL THEORY OF EMPLOYMENT, INTEREST AND MONEY* 162-63 (1964).

<sup>42</sup> See BERNSTEIN, *supra* note 41, at 57-72. The serious study of risk began during the Renaissance. *Id.* at 3. One of the first major breakthroughs was the discovery of probability theory in 1654 by Chevalier de Méré, Blaise Pascal and Pierre de Fermat. *Id.* at 57-72. The law of probability and statistics then became the cornerstone of the study of modern finance, as well as a wide range of natural and social sciences.

<sup>43</sup> Some of the most important breakthroughs in financial economics occurred in only the past fifty years. The revolution in financial thought arguably began in 1952 when Harry Markowitz showed the quantitative relationship between risk and reward. See *infra* note 45 and accompanying text; see also Christopher Farrell, *Three Wise Men of Finance*, *BUSINESS WEEK*, Oct. 11, 2004, at 20 (noting the pioneering works of Markowitz, William Sharpe and Merton Miller, and their theories on efficient portfolios, option pricing and capital asset pricing, as having profound impacts on modern finance).

<sup>44</sup> See *infra* text accompanying notes 228-230 (discussing the Efficient Portfolio Theory in the context of litigation risks); *infra* Section V.C & Section VI.C (discussing the Capital Asset Pricing Model in the context of comparing the underlying economic asset value of a firm to a person and discussing damage valuation); *infra* Section V.D & Section VI.B (discussing the Black-Scholes Option Pricing Model in the context of damage valuation under an option pricing theory).

Until recently, no one could quantify the concept of market risk or the effect of individual stock selections on a portfolio's risk-reward profile. That changed when Harry Markowitz proposed the Efficient Portfolio Theory in 1952. He showed that it is mathematically superior to diversify one's investments in an efficient portfolio rather than to concentrate all investments in a single basket.<sup>45</sup> Markowitz noted that any given investment is subject to two forms of risk: market and unique risk.<sup>46</sup> Market risk is the risk that cannot be reduced by diversification: the general, systemic risk that can adversely affect all stocks (e.g., risk of market downturn, interest rate movements, political-economic developments, etc.).<sup>47</sup> Unique risk is the risk associated with an investment in a particular company (e.g., quality of management, competitive positioning, financial resources, and the like).<sup>48</sup> A well-diversified portfolio can mitigate the unique risk and approximate the remaining market risk.<sup>49</sup>

In an uncertain world of limited resources, risk and reward are conjoined twins. The level of risk assumed is a discretionary matter depending on the individual investor's preference. Markowitz's insight was not that risk was bad per se, but that unnecessary risk was not good (a concept that should be readily apparent in increased risk cases as well).<sup>50</sup> He proved that portfolios can be structured so that for each level of risk appetite there is an efficient portfolio that maximizes expected returns.<sup>51</sup> Thus he proved that unnecessary risk can be reduced by the stock selection in a portfolio.<sup>52</sup> Today, diversification of risk is the keystone concept of corporate finance and investment management, and the Efficient

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<sup>45</sup> Harry Markowitz, *Portfolio Selection*, 7 J. FIN. 77, 77 (1952) ("[A] rule of behavior which does not imply the superiority of diversification must be rejected both as a hypothesis and as a maxim.").

<sup>46</sup> RICHARD BREALEY & STEWART MYERS, *PRINCIPLES OF CORPORATE FINANCE* 137 (4th ed. 1991).

<sup>47</sup> See Markowitz, *supra* note 45, at 79 ("Diversification cannot eliminate all variance."). Market risk is sometimes called systemic or undiversifiable risk. BREALEY & MYERS, *supra* note 46, at 137.

<sup>48</sup> Unique risk is sometimes called unsystemic, diversifiable, specific or residual risk. BREALEY & MYERS, *supra* note 46, at 137.

<sup>49</sup> Markowitz, *supra* note 45, at 79.

<sup>50</sup> Markowitz observed that most investors consider "yield to be a good thing; risk, a bad thing; gambling, to be avoided." *Id.* at 91.

<sup>51</sup> *Id.* ("There is a rate at which the investor can gain expected return by taking on variance, or reduce variance by giving up expected return.").

<sup>52</sup> *Id.* at 80-90.

Portfolio Theory was the theoretical precursor to the growth of the modern mutual fund industry.<sup>53</sup>

Prior to the mid-1960s, the market did not have a generally accepted theory to value a firm because there was no method to quantify the risk associated with the firm.<sup>54</sup> Without the ability to quantify the risk, valuation was largely a qualitative assessment.<sup>55</sup> William Sharpe, John Lintner and Jack Treynor solved this problem with the Capital Asset Pricing Model ("CAPM").<sup>56</sup> Under CAPM, all equity investments are compared to the expected return of the general market,<sup>57</sup> and a linear regression is

<sup>53</sup> The theory is so ingrained today that even novice investors are familiar with the concept of diversification. Interestingly, diversification was not a new idea when Markowitz first championed his theory. The concept has been noted in curious places. For example, Antonio—the merchant in Shakespeare's *The Merchant of Venice*—explained his investment strategy this way: "My ventures are not in one bottom trusted, nor to one place; nor is my whole estate upon the fortune of this present year; Therefore, my merchandise makes me not sad." WILLIAM SHAKESPEARE, *THE MERCHANT OF VENICE*, act 1, sc. 1, cited in BERNSTEIN, *supra* note 41, at 93.

<sup>54</sup> "Throughout most of the history of stock markets . . . it never occurred to anyone to define risk with a number. Stocks were risky and some were riskier than others, and people let it go at that. Risk was in the gut, not in the numbers." BERNSTEIN, *supra* note 41, at 247.

<sup>55</sup> This approach is seen in Graham & Dodd's classic treatise on security valuation, which set forth the following theory of stock valuation: "The value of a common stock depends entirely upon what it will earn in the future." BENJAMIN GRAHAM & DAVID DODD, *SECURITY ANALYSIS: THE CLASSIC 1940 SECOND EDITION* 351 (1962). Yet when Graham and Dodd stated this "complete revolution in the philosophy of common-stock investment" in 1940, they were unable to quantify the risk, and so could not calculate value. *Id.* at 352, 362. This "lack of well-defined and authoritative views" of valuation prompted them to counsel that stocks should be valued largely on qualitative assessments that are "reasonable," one parameter being past performance, and that achieve sufficient diversification. *Id.* at 362-71.

<sup>56</sup> See John Lintner, *The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets*, 47 REV. ECON. & STAT. 13 (1965); William F. Sharpe, *Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk*, 19 J. FIN. 425 (1964). Treynor's article has not been published. BREALEY & MYERS, *supra* note 46, at 161 & n.9.

<sup>57</sup> BREALEY & MYERS, *supra* note 46, at 162. Data on the market risk premium, defined as the market return minus the risk free rate, is readily available. Between 1926 and 1993, the arithmetic average of the market risk premium was 6.9% and the geometric average return was 5.0%. THOMAS E. COPELAND ET AL., *VALUATION: MEASURING AND MANAGING THE VALUE OF COMPANIES* 260-61 (2d ed. 1995). Arithmetic return average is the average of the year over year return for any given time period. Geometric return average is the compound internal rate of return from the beginning to the ending time period. *Id.* Based on these data, Copeland et al. recommend that the market risk premium be five to six percent. *Id.* at 260. General practices in the financial markets are consistent with these rates. See G. BENNETT STEWART, III, *THE QUEST FOR VALUE: A GUIDE FOR SENIOR MANAGERS* 438 (1991) ("Is there any fundamental reason why market risk premium should be 6%? Not that I can figure. The question is a little like asking why did God make pi the number 3.14159 . . . Don't ask. Just memorize it, and then head out to recess.").

calculated.<sup>58</sup> In mathematical terms, the linear regression calculates the slope of the stock's returns against expected market return, the slope value being the beta.<sup>59</sup> The beta then is the comparative measure of the expected stock return versus the market return.<sup>60</sup> For instance, if the expected market return is 10%, a stock with a 2.0 beta means that the expected return of that stock is 20%. A firm's risk premium is defined as the measure of the overall risk associated with that stock, i.e., the expected return necessary to induce a rational investor to invest in that particular stock given its unique risks.<sup>61</sup> CAPM measures the risk premium relative to the market return and the risk-free investment rate, both of which are easily calculable.<sup>62</sup> Based on this understanding of a stock's relative risk, CAPM postulates that the risk premium for any given asset is  $R_a = \beta (R_m - R_f) + R_f$ , where  $R_f$  is the risk-free rate,<sup>63</sup>  $R_m$  is the market return, and  $\beta$  is the stock's beta.<sup>64</sup> With a theory to measure a stock's unique risk profile, investors were

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<sup>58</sup> Linear regression is a statistical technique that takes a set of data points and finds the line that best fits the data. See STEWART, *supra* note 57, at 440-41 (discussing beta regression).

<sup>59</sup> BREALEY & MYERS, *supra* note 46, at 183-89. The regression and the slope are expressed in the formula:  $R_a = a + (\beta \times R_m) + e$ , where  $R_a$  is the return for a specific asset,  $R_m$  is the market return,  $a$  and  $\beta$  are the intercept and slope of the regression of  $R_a$  and  $R_m$ , and  $e$  is the error term.

<sup>60</sup> *Id.* at 162. Betas are unique to each company and may change over time. Also, each business sector has a risk profile as seen by average betas throughout different industries. See STEWART, *supra* note 57, at 451-52 (discussing betas for various industries).

<sup>61</sup> BREALEY & MYERS, *supra* note 46, at 183-84.

<sup>62</sup> *Id.* at 180.

<sup>63</sup> In the investment world, only U.S. Treasury securities are considered completely risk-free. *Id.* at 159, 161. Even when there is no risk, an investor still expects to earn a return because of the time value of money. Yields on Treasury bills, notes and bonds are commonly used as the prevailing risk-free rates in many financial calculations including the Black-Scholes formula, the CAPM, and the weighted average cost of capital calculation for cost of capital. All other investments are associated with a certain risk for which there must be commensurate expectation of reward.

<sup>64</sup> CAPM can be understood as calculating the opportunity cost of equity. An investor has a spectrum of investment choices. She can invest in a risk-free investment (i.e., U.S. Treasury instruments) or alternative investments with a range of risk. The greater the risk, the greater the expected return on the investment for the risk taken. The investor can also invest in a portfolio or index that closely approximates the market return. The term  $(R_m - R_f)$  is the measure of expected market return in excess of the risk-free rate. This net return is the market risk premium. See *supra* note 57. An equity investment is then compared against the market risk premium as weighted by the beta. This measure captures the expected return requirements for the risks taken on the particular stock, net of the risk-free rate which is then added back to calculate the overall expected return for that investment. Thus, CAPM answers the simple question: How much return is needed to entice an investor to invest in that particular stock vis-à-vis a risk-free investment or a market portfolio?

given the tools needed to value an asset using a risk-based, quantitative method rather than qualitative or accounting assessments, as was the case before CAPM.<sup>65</sup>

Until recently, option pricing also suffered from a lack of a disciplined valuation methodology. An option is one of the most basic forms of a derivative security.<sup>66</sup> It gives the holder the right but not the obligation to buy or sell an underlying asset, typically a stock, for a fixed price within a specified time period.<sup>67</sup> Despite the simplicity of an option contract, its valuation was elusive. In 1973, Fischer Black and Myron Scholes solved this problem.<sup>68</sup> Although mathematically complex, the Black-Scholes option pricing formula revolves around the concept that option value is dynamic and multivariate. The formula captures the interplay of six variables on option value: the current stock price, the strike price, time to maturity, the volatility of the stock, dividend yield, and the risk-free rate. All else being equal, each factor was understood to affect option value,<sup>69</sup> but no one could calculate the effect on value for the infinite permutations of the six variables until the publica-

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<sup>65</sup> The CAPM has been criticized on the basis that beta does not accurately measure asset returns. See, e.g., Eugene F. Fama & Kenneth R. French, *The Cross-Section of Expected Stock Returns*, 47 J. FIN. 427, 428 (1992) ("In short, our tests do not support the most basic prediction of the [CAPM] that average stock returns are positively related to market beta."). Despite these concerns, "CAPM combines so many strands of theoretical innovation that it remains the keystone of investment theory, theories of market behavior and the allocation of capital in both private and public enterprises." Michael Peitz, *Is This the Night of the Living Beta?*, INSTITUTIONAL INVESTOR, June 1992, at 42 (quoting Peter Bernstein). Cf. PETER BOSSAERTS, *THE PARADOX OF ASSET PRICING* x (Princeton Univ. Press 2002) ("To put this differently, asset pricing is paradoxical. On the one hand, the theory is so persuasive that it is widely believed to be correct, to the point that business and both the executive and jurisdictional [sic] parts of government appeal to it. Yet there is little evidence that the theory explains the past, let alone that it predicts the future."). In investment banking and corporate finance practices, CAPM and the Discounted Cash Flow analysis are the primary analytic tools to conduct a theoretical valuation.

<sup>66</sup> JOHN HULL, *OPTIONS, FUTURES AND OTHER DERIVATIVES* 1 (3d ed. 1997).

<sup>67</sup> See *infra* Section II.D (discussing options).

<sup>68</sup> Fischer Black & Myron Scholes, *The Pricing of Options and Corporate Liabilities*, 81 J. POL. ECON. 637 (1973); see also JOHN C. COX & MARK RUBENSTEIN, *OPTIONS MARKETS* 1204-12 (1985) (presenting Black-Scholes formula and the underlying mathematical concepts); Peter H. Huang, *Teaching Corporate Law from an Option Perspective*, 34 GA. L. REV. 571 (2000) (discussing options without the mathematical details). Huang provides a number of graphs and charts that explain the characteristics of various options and option trading strategies. *Id.* at 582-91.

<sup>69</sup> For call options, increasing the following variables while keeping all other variables the same has the following increasing (↑) or decreasing (↓) effects on option value: stock price (↑), strike price (↓), time to maturity (↑), volatility (↑), risk-free rate (↑), and dividends (↓). HULL, *supra* note 66, at 157. For put options, the effects are: stock price (↓), strike price (↑), time to maturity (↑), volatility (↑), risk-free rate (↓), and dividends (↑). *Id.*



tion of the Black-Scholes formula.<sup>70</sup> Similar to the way the Efficient Portfolio Theory cultured the mutual fund industry, the Black-Scholes theory sparked the explosive growth of the modern derivatives market.<sup>71</sup>

### B. Credit Valuation

The measure of a firm's value depends on its bundle of risks and potential returns, which together constitute uncertainty and value. Risk affects all aspects of the firm's operations and valuation, including the issuance of debt and equity securities.<sup>72</sup> A firm incurs a cost for issuing any security instrument, and such costs are determined by a combination of the firm's unique risk profile and the general market risk. The higher a firm's risk, the higher is the expected return on the instrument, and either the cash flow yield must be higher and/or the valuation must be lower to provide the investor with a higher return.<sup>73</sup>

As ancient societies grew to understand risk, they began to trade it and markets were created. One of the simplest forms of risk trade is the market for credit. Credit long predated industry, bank-

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<sup>70</sup> The Black-Scholes formula can now be programmed into a handheld calculator and there are a number of websites that calculate option value. For example, how much is an option in a share of IBM worth on December 9, 2003 if the stock price closed at \$90.63, the option strike price is \$110, and the option expires two years on December 9, 2005? If we assume a dividend yield of 0.7%, a risk-free rate of 4.5%, and volatility of 20%, then as of December 9, 2003, the option was worth \$5.94. See <http://www.numa.com/derivs/ref/calculat/option/calc-opa.htm> (providing a Black-Scholes option calculator on the Internet) (last visited Nov. 8, 2004). The theoretical option value changes daily because the time to maturity changes as well as the other factors. While the calculation can be mechanical, option valuation is far from rote. The valuation depends on calculations and assumptions of future volatility and risk-free rates. Like anything else, trading in options involves in large part a disciplined understanding of the fundamentals of a very technical subfield of finance, a healthy portion of intuition and a little bit of luck.

<sup>71</sup> See MERTON H. MILLER, MERTON MILLER ON DERIVATIVES 3 (1997) (describing the tremendous growth of the derivatives market in the 1990s); Niall Ferguson, *Who's Buried by Higher Rates?*, FORTUNE, June 21, 2004, at 70 (noting that since December 2000, "the gross market value of over-the-counter derivative contracts has grown from \$3 trillion to nearly \$8 trillion" according to the Bank for International Settlements); see also Kimberly Krawiec, *More than Just "New Financial Bingo": A Risk-Based Approach to Understanding Derivatives*, 23 IOWA J. CORP. L. 1 (1997) (discussing the legal and financial risks of derivatives).

<sup>72</sup> There are also hybrid instruments such as preferred stocks, convertible bonds and convertible preferred stocks, which have characteristics of both debt and equity.

<sup>73</sup> In consideration, the issuer can give the investor money (e.g., interest payments), concessions in valuation (e.g., issuing shares at lower prices), or a combination of monetary payments and valuation concessions (e.g., convertible bonds or preferred shares).

ing, coinage, and probably primitive forms of money.<sup>74</sup> Like equity, credit has two risks: the unique creditworthiness of the borrower, and the prevailing market cost of credit.<sup>75</sup> The higher the risk of default or the cost of funds, the greater is the cost of debt. Keynes described the risk-reward concept embedded in the theory of interest rates:

For if a venture is a risky one, the borrower will require a wider margin between his expectation of yield and the rate of interest at which he will think it worth his while to borrow; whilst the same reason will lead the lender to require a wider margin between what he charges and the pure rate of interest in order to induce him to lend (except where the borrower is so strong and wealthy that he is in a position to offer exceptional margin of security).<sup>76</sup>

This concept applies equally to sovereign bonds of nations and consumer credit cards.

The cost of debt is intuitively understood. It is the interest expense on borrowing.<sup>77</sup> Because interest expense is paid in cash or recognized as an accrued liability, it is an out-of-pocket economic cost, something the law has no trouble recognizing as a tangible cost.<sup>78</sup> The interest rate depends on credit quality, which assesses the riskiness of the borrower.<sup>79</sup>

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<sup>74</sup> SIDNEY HOMER & RICHARD SYLLA, *A HISTORY OF INTEREST RATES* 3 (3d ed. 1991). Homer and Sylla note that Hammurabi, *circa* 1800 B.C., regulated interest rates (33.33% for loan on grain and 20% for loans on silver) and explicitly provided for collateralization by debt slavery subject to a three year limit. *Id.*

<sup>75</sup> BREALEY & MYERS, *supra* note 46, at 663.

<sup>76</sup> KEYNES, *supra* note 41, at 145.

<sup>77</sup> Less intuitive are zero coupon bonds, which are priced at a discount to face value. The cost of debt is the discount, which reflects the credit risk of the issuer/borrower, and the interest cost is calculated by the yield to maturity. Credit instruments are compared based on yield to maturity rather than the nominal interest rate. Yield to maturity represents the internal rate of return for the bond. The yield represents the true interest charge based on the purchase price or the fair market value of the credit instrument, and allows a true comparison of various credit instruments. See BREALEY & MYERS, *supra* note 46, at 562 (discussing yield to maturity and term structure of interest rates).

<sup>78</sup> Accordingly, the law protects an individual's freedom from wrongfully imposed interest expenses. See Fair Credit Reporting Act ("FCRA"), 15 U.S.C. §§ 1681-1681x (2004).

<sup>79</sup> The debts of firms and sovereign nations are evaluated by professional rating agencies. Two of the most prominent agencies are Moody's Investor Service and Standard & Poor's. For individuals, creditworthiness is evaluated by credit reporting agencies such as Trans Union, Experian, and Equifax.

### C. Equity Valuation

Equity is the ownership interest in a business venture. The concept of equity incorporates the *raison d'être* of a community: collective self-advancement and economic benefit through cooperative enterprise.<sup>80</sup> Although no one knows for certain when the first equity investment was made, we can speculate that it took place when primitive humans learned that hunting in a partnership was more fruitful than a solo effort. Equity interest became more commoditized with the invention of the corporate form, which is the dominant economic institution of the modern era and the form most conducive to public trading.<sup>81</sup> As with the cost of credit, the cost of equity reflects the underlying risk.<sup>82</sup> But unlike credit costs, equity costs are not as accessible because the cost is not in the form of an immediate monetary payment like interest expense, but rather is embedded in the firm's valuation. Nevertheless, the cost of equity is no less tangible or consequential.

Equity valuation depends on how value is perceived. A share of stock in a firm can be viewed in two ways. Under the accounting view, a share derives its value from the assets of the firm, or at least

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<sup>80</sup> See ROBERT L. HEILBRONER, *THE WORLDLY PHILOSOPHERS: THE LIVES, TIMES, AND IDEAS OF THE GREAT ECONOMIC THINKERS* 18-19 (7th ed. 1999).

<sup>81</sup> In Western society, the concept of the corporation was well-established at the beginning of the Middle Ages, when it was applied to ecclesiastical bodies, civic entities like boroughs, and craft and trade guilds, which collectively formed the dominant economic institutions of the era. D.L. Mazumdar, *The Modern Corporation and the Rule of Law*, 114 U. PA. L. REV. 187, 187 (1965). Gradually, the legal concepts associated with the corporate form took root: independent personage, indefinite survival, capacity to own property, and the right to sue and be sued. *Id.* at 187-88. By the middle of the 16th century, the corporate form was used to set up national mercantile organizations of the type of the Chartered Companies of the 16th, 17th and 18th century, the most famous being the East India Company. *Id.* at 188. By the second half of the 19th century, the corporation became the dominant form of industrial enterprise in all Western countries. *Id.* at 189.

<sup>82</sup> Stocks are generally riskier than bonds for several reasons. Bonds are contracts in which the issuer promises to repay the loan and that promise is ultimately secured by the assets of the issuer. On the other hand, stocks are subordinate to bonds in a liquidation, and generally there is no commitment or requirement to pay dividends. Some bonds, primarily high yield or "junk" bonds, are so risky that their yields approximate returns on equity. BREALEY & MYERS, *supra* note 46, at 663-64.

a subordinate claim on those assets.<sup>83</sup> Equity then is balance sheet driven (defined as assets minus liabilities), a tangible concept.<sup>84</sup>

Under the finance perspective, equity is viewed as a participation in the firm's risk. It is not a residual asset but rather a contingent claim on the future earnings of the firm as discounted by risk.<sup>85</sup> Market value depends on an evaluation of the firm's risks as compared to the potential rewards.<sup>86</sup> The greater the anticipated earnings, the greater is the valuation; as a corollary, the greater the perceived risk to earnings, the less is the valuation.<sup>87</sup> Value is not a function of the value of assets and liabilities,<sup>88</sup> but depends on the interrelationship between the stream of anticipated earnings and its associated risks.<sup>89</sup> We can see this concept at work by examin-

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<sup>83</sup> GERALD WHITE ET AL., *THE ANALYSIS AND USE OF FINANCIAL STATEMENTS* 13 (1994) ("Equity is therefore the residual interest in the net assets of an entity that remains after deducting its liabilities."). The components of stockholder equity are the paid in capital, which is the money contributed by shareholders to purchase a newly-issued share, and the retained earnings, which are the accumulation of net earnings after dividends are paid. *Id.* at 19-20.

<sup>84</sup> This is readily understood by the accounting equation: Assets = Liabilities + Equity. *Id.* at 13. The equity in a financial statement is typically called the book value. In a liquidation, the "breakup" value of the firm depends on the fair market value of assets and liabilities vis-à-vis the book value. Upon liquidation, a company's assets are first distributed to creditors, and whatever is left is apportioned pro rata between equity holders. In many liquidations, there are no more assets left over, and the equity holders are simply out of luck. See Note, *Switching Priorities: Elevating the Status of Tort Claims in Bankruptcy in Pursuit of Optimal Deterrence*, 116 HARV. L. REV. 2541, 2557 (2003) ("In liquidation, however, it is uncommon for equity to be paid anything even in the best of circumstances . . ."). Regardless of whether assets and liabilities are considered under book or fair market value, equity is seen as a balance sheet item under the accounting view.

<sup>85</sup> See COPELAND ET AL., *supra* note 57, at 26 ("[E]quity holders . . . are the *residual* claimants on the cash flows of a company.").

<sup>86</sup> *Id.* at 27. Risk drives the cost of capital for each firm, also known as the weighted average cost of capital (WACC).

<sup>87</sup> A firm with a higher volatility of earnings will be valued less than one with a lower volatility, all else being equal. Volatility of earnings shows that the expected cash flows are subject to higher risk. Higher risk is not a good thing and must be compensated by higher returns to the investor, which is accomplished by lower valuations. Thus, certain companies or industries have traditionally suffered from lower valuation multiples than others due to the perceived comparative risk.

<sup>88</sup> See COPELAND ET AL., *supra* note 57, at 76 (noting that "the DCF model is conceptually superior to the accounting model"). This is a general statement, and there are some notable exceptions. Some businesses that earn profits primarily from yields on assets are driven by the net asset value. Banks, insurers, and some real estate companies fall into this category. Also, valuations for the purposes of mergers and acquisitions sometimes employ "breakup" valuation techniques. It is beyond the scope of this article to delve into these matters.

<sup>89</sup> In practice, book value will seldom reflect the fair market value of the equity. This accounts for the difference between market and book values. For example, as of September 30, 2003, IBM reported in its 10-Q that shareholders' equity was \$27.3 billion. As of

ing how the CAPM is used to value stock in the Discounted Cash Flow ("DCF") method of valuation.

The DCF method is the primary theoretical basis for calculating a firm's equity value in the financial markets today.<sup>90</sup> Although the DCF is technically more detailed, it is conceptually similar to its distant legal cousin, the pecuniary loss method used for wrongful death cases.<sup>91</sup> In principle, both the DCF and the pecuniary loss methods involve projecting a series of finite cash flows and then discounting them to calculate a present value. Under the DCF, the present value of a firm is calculated for a finite series of projected free cash flows, representing the residual cash available to stockholders after payment for continuing operations, capital investments, debt expense and taxes.<sup>92</sup>

Present value incorporates the concept of time value of money. Money has time value in that a dollar today is worth more than a dollar tomorrow.<sup>93</sup> There are two reasons for this. First, inflation decays nominal future value.<sup>94</sup> Second, the future cash flow is sub-

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December 20, 2003, its market capitalization was approximately \$160.2 billion, 5.8 times more than the book equity.

<sup>90</sup> See COPELAND ET AL., *supra* note 57, at 71 ("[T]he value of a business is the future expected cash flow discounted at a rate that reflects the riskiness of the cash flow."). There are other variations of the DCF. See STEWART, *supra* note 57, at 2-4 (proposing that a firm should be valued on the economic value added (EVA) which is the sum of operating profits less the cost of capital).

<sup>91</sup> See RESTATEMENT (SECOND) OF TORTS § 913A (1965) ("The measure of a lump-sum award for future pecuniary losses arising from a tort is the present worth of the full amount of the loss of what would have been received at the later time."); *id.* § 925 cmt. b.1 ("[D]amages are determined by the present worth of the contributions and aid that the deceased probably would have made to the survivors had he lived."); see also DAN DOBBS, *THE LAW OF REMEDIES*, § 8.3(1), at 671 (2d ed. 1993). Under this method, an economist would estimate the average remaining length of life based on actuarial data and then project the anticipated earnings, which is then discounted back to present value. See, e.g., *Oliveri v. Delta S.S. Lines, Inc.*, 849 F.2d 742 (2d Cir. 1988) (still valid on issue of pecuniary loss, but overruled on the issue of discounting non-pecuniary losses); *In re Air Crash Disaster Near Chicago, Ill.*, on May 25, 1979, 644 F.2d 633 (7th Cir. 1981); PROSSER & KEETON, *supra* note 1, § 127, at 949-50.

<sup>92</sup> Free cash flow is defined as the after-tax operating earnings of the company, plus noncash charges, less investment in operating working capital, property, plant and equipment, and other assets. COPELAND ET AL., *supra* note 57, at 135.

<sup>93</sup> See *Oliveri*, 849 F.2d at 746 ("Because a dollar received in the future will almost surely have less purchasing power than a dollar has today, we have required estimates of lost future earnings to reflect the effect of inflation.").

<sup>94</sup> Inflation is a relatively modern concept. From 1800 to 1940, the cost of living increased on average 0.2% per year, and decreased on 69 different occasions. BERNSTEIN, *supra* note 41, at 184. But from 1940 to 1959, the cost of living increased on average 4.0% per year and increased every year except one. *Id.* Today, inflation is a given, and any financial projection should incorporate projected inflation. See COPELAND ET AL., *supra*

ject to risk of nonpayment and the opportunity cost of capital.<sup>95</sup> To calculate present value, a discount rate must be selected, and the formula for the present value calculation is: Present Value (PV) = Future Value (FV) x Discount Factor (DF). Where  $R$  is the discount rate and  $N$  is the year in which the future payment is expected to be received, the discount factor is calculated as:  $DF = 1 \div (1 + R)^N$ . Thus, the discount rate (a measure of risk) and the number of years (a measure of time) independently affect the discount factor.<sup>96</sup>

In a DCF calculation, a series of expected free cash flows,  $F_i$ , is projected. The discount rate  $R$  is calculated as the weighted average cost of capital,  $R_c$ , which is the blended cost of capital given the firm's unique capital structure.<sup>97</sup> The cost of credit is the average yield to maturity calculated by the total interest expense charged to the firm, and the cost of equity is the risk premium calculated by the CAPM.<sup>98</sup> With the cost of capital calculated, the value of a firm under the DCF is then:

$$\sum_{i=1}^{(N-1)} F_i \frac{1}{(1+R_c)^i} + \frac{F_N}{(R_c-g)} \times \frac{1}{(1+R_c)^{(N-1)}} .^{99}$$

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note 57, at 211-13; SIMON BENNINGA & ODED SARIG, *CORPORATE FINANCE: A VALUATION APPROACH* 20-23 (1997).

<sup>95</sup> Opportunity cost of capital in this context means that the dollar today can be invested to earn a return, while a dollar in the future would not have this opportunity. See BREALEY & MYERS, *supra* note 46, at 13.

<sup>96</sup> For instance, assume a future payment of \$100 two years from now. If the discount rate is 10%, then the discount factor is  $1 + (1 + 10\%)^2 = 0.8264$ , and the present value calculation is  $\$100$  (FV) x 0.8264 (DF) = \$82.64 (PV). If the discount rate is 20%, then the discount factor is  $1 + (1 + 20\%)^2 = 0.6944$ , and the present value calculation is \$69.44. A 10% difference in the discount rate results in a present value difference of \$13.20.

<sup>97</sup> The weighted average cost of capital can include any combination of debt, equity and preferred stock securities. It calculates the cost of capital based on the following equation:  $R = [C_d \times (1 - T) \times D + V] + [C_p \times P + V] + [C_e + E + V]$ , where  $T$  = marginal tax rate,  $C_d$  = pretax expected yield to maturity of nonconvertible debt,  $C_p$  = after-tax cost of capital of preferred stock,  $C_e$  = cost of equity determined by CAPM,  $D$  = total market value of debt,  $P$  = total market value of preferred stock,  $E$  = total market value of equity, and  $V$  = total market value of the firm ( $D + P + E$ ). COPELAND ET AL., *supra* note 57, at 240.

<sup>98</sup> *Id.* at 251-71.

<sup>99</sup> The last term,

$$\frac{F_N}{(R_c-g)} \times \frac{1}{(1+R_c)^{(N-1)}} ,$$

is called the present value of the terminal value, where  $g$  represents a stabilized growth rate of the firm. See COPELAND ET AL., *supra* note 57, at 277. We assume that most firms operate in perpetuity. The terminal value represents the value attributable to the continuing operations in perpetuity after the specific period of projections up to the  $N$ th year. The concept is illustrated by asking the question: How much would you pay now for the right to

Although the variance between market and theoretical values can be volatile as short term intervening factors influence the markets in unpredictable ways,<sup>100</sup> DCF valuations tend to correlate highly to market valuations in the long run.<sup>101</sup>

The DCF calculation is complex and tedious, if done properly,<sup>102</sup> but it incorporates a simple concept: value depends on how much cash flow is expected and the risks associated with that cash flow. The financial syllogism is simple. For companies that are higher risk, investors demand a higher expected return either in capital appreciation or earnings, and so the cost of equity is higher. This results in a greater discounting of the expected future cash flow, meaning that an investor's money will result in greater relative purchasing power of the ownership of that company.<sup>103</sup> Although the cost of equity is a less accessible concept than the cost of debt, it is just as real and consequential.<sup>104</sup>

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receive \$1 per year for an infinite period? If there were no risk of not getting paid (equity risk) and no risk of the dollar losing value over time (inflation), then the answer is an infinite amount. The calculation is:  $\$1 + 0 = \infty$ . But because we know that there are risks to that dollar, the value is less than an infinite sum. If we calculate the discount rate at 10%, then the present value of this infinite stream of dollars is \$10. The calculation is:  $\$1 + 10\% = \$10$ . For the terminal value, the term  $(R_c - g)$  is the perpetuity discount rate calculating the terminal value.

<sup>100</sup> As a result, reliance on the DCF for short-term investments is a perilous venture because any number of market factors can affect stocks in short intervals of time.

<sup>101</sup> COPELAND ET AL., *supra* note 57, at 83.

<sup>102</sup> The complexities surrounding a DCF valuation involve projecting future earnings. The projection must be based on rigorous due diligence of past and present operations and future forecasting. Moreover, the future earnings must then be tested by various assumptions (typically, optimistic, pessimistic and baseline views). After this forecasting process, a working model of the financial statements must be produced, from which the free cash flows are derived.

<sup>103</sup> This decrease in valuation has profound ramifications. Capital is the lifeblood of a company, and lower valuations mean that a firm must give up more of its ownership, relatively speaking, to raise new equity capital. This concept has fundamental implications throughout all aspects of corporate finance activities, including initial and secondary public offerings, mergers and acquisitions, venture capital fundraising and financial restructurings. It is beyond the scope of this article to discuss these matters in detail.

<sup>104</sup> The concept of the cost of equity is at the center of a current accounting reform movement that seeks to expense the cost of employee stock option benefits. Traditionally, the granting of stock options has not been expensed in the income statement as an item for salary and compensation. When equity costs are considered, this practice had the effect of artificially inflating a firm's earnings. See Financial Accounting Standards Board, Proposed Statement of Financial Accounting Standards: Share-Based Payment, Amendment of FASB Statements 123 and 95 (Mar. 31, 2004), available at [http://www.fasb.org/draft/ed\\_intropg\\_share-based\\_payment.shtml](http://www.fasb.org/draft/ed_intropg_share-based_payment.shtml) (proposing the expensing of employee stock option plans); see also Kathryn Kranhold & Mitchell Pacelle, *About Those Big Enron Bonuses . . .*, WALL ST. J., June 12, 2002, at C1 (describing stock option plans at Enron and criticism of them); Opening Statement of Ranking Democratic Member Paul E. Kanjorski: Hearing on the Accounting Treatment of Employee Stock Options Before the House Sub-

#### D. Option Valuation

The best example of the inherent value of risk is seen in derivatives. A derivative, such as a call or put option, is a security whose value “derives” from some other asset, typically a stock. Its fundamental nature is a contingent claim where value is assigned to the contingency.<sup>105</sup> It is a contractual bet placed in the financial market. The derivatives market is the purest form of a financial trade in risk because a derivative is quite simply the securitization of uncertainty.<sup>106</sup> In the market, derivatives are used as a double edged sword: they can be used to minimize risk exposure through hedging or maximize it through leveraged speculation.<sup>107</sup>

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*committee on Capital Markets, Insurance, and Government Sponsored Enterprises*, 108th Cong. 1 (Jun. 3, 2003), available at <http://financialservices.house.gov/media/pdf/060303ka.pdf> (last visited Nov. 9, 2004) (“Employee stock options are a type of compensation, just like a salary or a bonus. Because compensation is an expense and because expenses influence earnings, employee stock options should be counted against earnings and subtracted from income. My opinion is shared by many others, including such respected financial experts as Warren Buffett, Alan Greenspan, and Joseph Stiglitz.”).

<sup>105</sup> The contingency is typically the price of a traded security or market index. HULL, *supra* note 66, at 1.

<sup>106</sup> “The product in derivative transactions is uncertainty itself.” BERNSTEIN, *supra* note 41, at 314.

<sup>107</sup> Hedging is a term used to describe the mitigation of risk through the use of derivatives or other risk management techniques. HULL, *supra* note 66, at 11. See also Niall Ferguson, *Who’s Buried by Higher Rates?*, FORTUNE, June 21, 2004, at 70 (finding that more than 80 percent of the world’s top 500 companies use derivatives to hedge against interest rate risk according to the International Swaps and Derivatives Association). Consider the simple case of a U.S. company that does significant business in Korea. The company is exposed to the risks of fluctuation of the value of the Korean won against the U.S. dollar. Currency fluctuations may result in volatile earnings, which are reported in dollars. Volatility of earnings is not a good thing for public companies because such companies are considered more risky. If the company is concerned that the Korean won will lose value against the U.S. dollar, it can hedge this risk by entering into a futures contract to fix a specific exchange rate. Or the company can buy put options on the Korean won so that as the won decreases in value the option will have a payoff that would match the currency translation loss. Thus the foreign currency risks can be managed by hedging, resulting in smoother earnings.

Derivatives can also be used for leveraged speculation. See HULL, *supra* note 66, at 11-12. Unlike an investment in the underlying assets investments in derivatives require little upfront capital investment. Accordingly, a speculator can assume significant risk exposure, or, in financial parlance, “leverage” a position. As the trading position changes with time, margin calls may require a portion of the current loss to be paid by the investor from time to time as the derivatives are marked-to-market. *Id.* at 20-24. Marked-to-market refers to the process of continually updating market value as the derivative changes value with time. *Id.* Generally, however, complete settlement takes place upon exercise of the option or expiration of the maturity date (i.e., a buy now, pay later scheme). Therefore, derivatives allow an investor to assume enormous risk without the concomitant capital investment required for investment in the underlying asset like a stock purchase. The 1990s saw some spectacular losses as a result of improper hedging strategies and raw speculation, including the bankruptcy of Orange County, California (losses of over \$2 billion) and Barings PLC



A financial option is not a modern concept. Aristotle described financial options as devices involving "a principle of universal application" and recounted how they were used to monopolize the ancient olive oil market.<sup>108</sup> The simplest option is one that gives the right to buy or sell a single share of common stock.<sup>109</sup> A call option is a contract whereby for a premium the buyer/holder has the right to buy a share of a common stock from the seller/writer at an agreed strike price during a fixed time period.<sup>110</sup> A put option gives the buyer the right to sell the underlying asset.<sup>111</sup> For either kind of option, we denote  $P$  for premium,  $S$  for stock price and  $X$  for strike price. The strike price is the defined contingency upon which the counterparties are placing their financial bets.

For a call option, if the stock price is greater than the premium plus the strike price ( $S > P + X$ ), then the call option is "in the money" and the profit for the buyer is  $(S - X - P)$ .<sup>112</sup> If the strike price plus the premium equals the stock price ( $S = P + X$ ), the option is "at the money" and the parties break even. If the stock price is less than the strike price plus the premium ( $S < P + X$ ), the option is "out of the money" and the buyer's maximum loss is capped at  $P$ . So the seller and buyer are betting the stock will fall

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(losses of over \$1 billion). See Krawiec, *supra* note 71, at 2-3 & n.5 (discussing the enormous losses of various investors and firms); JOHN GAPPER & NICHOLAS DENTON, *ALL THAT GLITTERS: THE FALL OF BARINGS* (1996) (recounting the demise of Baring Brothers due to speculative derivatives trading).

<sup>108</sup> In *Politics*, Aristotle explained how the philosopher Thales purchased option contracts to monopolize the olive press market:

There is the anecdote of Thales the Milesian and his financial device, which involves a principle of universal application, but is attributed to him on account of his reputation for wisdom. He was reproached for his poverty, which was supposed to show that philosophy was of no use. According to the story, he knew by his skill in the stars while it was yet winter that there would be great harvest of olives in the coming year; so, having a little money, he gave deposits for the use of all the olive-presses in Chios and Miletus, which he hired at a low price because no one bid against him. When the harvest-time came, and many were wanted all at once and of a sudden, he let them out at any rate which he pleased, and made a quantity of money.

ARISTOTLE, *POLITICS*, bk.1, ch.11, *reprinted in THE BASIC WORKS OF ARISTOTLE* 1142 (Richard McKeon ed., 2001) (n.d.). Aristotle recounted this story to point out that philosophers too could easily engage in commercial enterprise but that philosophy was a worthier pursuit.

<sup>109</sup> Black & Scholes, *supra* note 68, at 637. There are two varieties of options: American options can be exercised at any time up to the expiration date, whereas European options can be exercised only on the expiration date. HULL, *supra* note 66, at 5. Most options traded on exchanges are American. *Id.*

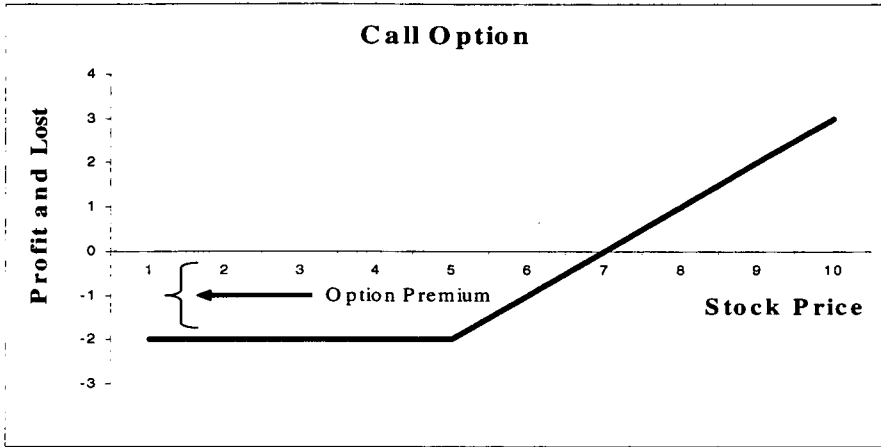
<sup>110</sup> COX & RUBENSTEIN, *supra* note 68, at 1.

<sup>111</sup> *Id.* at 3.

<sup>112</sup> See *id.* at 1-3 (describing the payoff matrix for call options).

and rise, respectively.<sup>113</sup> These concepts are best visualized through graphs. Figure 1 is a profit and loss schematic for the buyer of a call option with a strike price of \$5 and a premium of \$2.

FIGURE 1



The Y-axis represents the profits or loss, and the X-axis is the range of stock prices. The kinked line represents the profit and loss as a function of stock price.

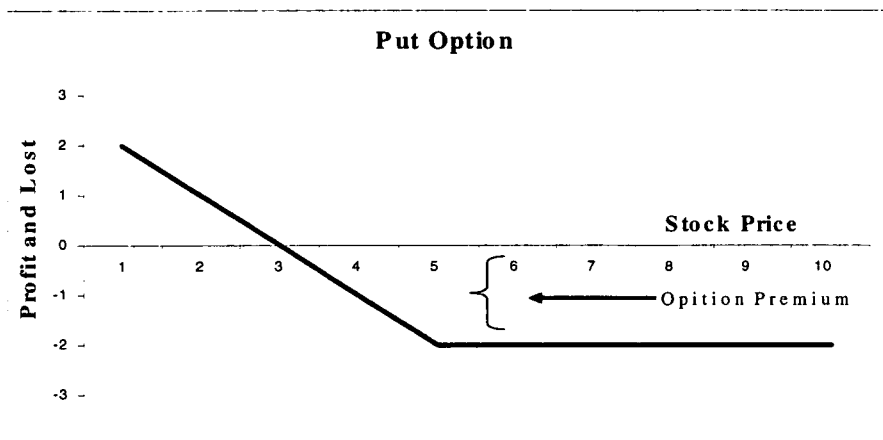
A put option is the mirror opposite of a call option. For a put option, if the stock price is less than the strike price minus the premium ( $S < X - P$ ), the put option is "in the money" and the buyer's profit is  $(X - S - P)$ .<sup>114</sup> The seller's maximum theoretical loss is  $(X - P)$  if the stock price becomes nil, and the maximum gain is  $P$ . If the stock price equals the strike price minus the premium ( $S = X - P$ ), the option is "at the money." If the stock price is greater than the strike price plus premium ( $S > X - P$ ), the option is "out of the money." So the seller and buyer are betting the stock will rise and fall, respectively. Figure 2 is a profit and loss schematic of a buyer of a put option with a strike price of \$5 and a premium of \$2.

Lest one consider options and other derivatives to be the sole domain of financial engineers and sophisticated investors, an

<sup>113</sup> While the above are the most basic derivatives, financial engineers can take various combinations of calls, puts, swaps, futures and forwards to synthetically create any risk profile an investor wishes. See *id.* at 8-23 (describing some of the common option trading strategies including vertical straddles, vertical combinations, butterfly spreads and bullish and bearish vertical spreads); HULL, *supra* note 66, at 179-191 (same).

<sup>114</sup> See COX & RUBENSTEIN, *supra* note 68, at 3-5 (describing the payoff matrix for put options).

FIGURE 2



option is created anytime there is a possibility of two or more alternatives. All options, financial or otherwise, have value, which is to say that the underlying uncertainty has value. The pricing of options is set in various ways. The value of the option can be arbitrarily assigned as in the case of a lottery ticket, qualitatively assessed as in the case of a personal choice, or quantitatively calculated as in the case of an exchange-traded financial option. Nevertheless, the idea that options have value extends across a range of social endeavors.<sup>115</sup>

Perhaps the simplest option is a lotto ticket. A lottery ticket represents a contingent claim on a jackpot, and until the drawing the chance has some value. The price of a lottery ticket is arbitrary, for it is always the same and always more than the expected value of winning.<sup>116</sup> Just because a lottery ticket has not manifested into a winner does not mean that it was worthless when purchased.<sup>117</sup> The chance (or risk) has some value. It is not surprising then that,

<sup>115</sup> See Peter H. Huang, *A New Options Theory for Risk Multipliers of Attorney's Fees in Federal Civil Rights Litigation*, 73 N.Y.U. L. REV. 1943, 1951 (1998) (characterizing marriage, suicide and legal reform as options).

<sup>116</sup> "The world neither ever saw, nor ever will see, a perfectly fair lottery; or one in which the whole gain compensated the whole loss; because the undertaker could make nothing by it." SMITH, *supra* note 41, at 124.

<sup>117</sup> See *infra* text accompanying notes 289-292 (discussing the property nature of a lottery ticket).

in arguing increased risk creates negative value, some scholars have analogized increased risk cases to lottery-like situations.<sup>118</sup>

Another common example of an option is an ordinary insurance contract.<sup>119</sup> Insurance is a contract whereby the insured pays a premium in consideration for the insurer's assumption of certain specified risk of loss. Insurance is a contingent claim on a future loss—the very essence of a derivative. The profit and loss characteristics of an insurance policy behave in exactly the same fashion as a put option.<sup>120</sup> An insured seeks to protect against (or speculate on) the occurrence of a loss, similar to the way the holder of a put option is betting that the underlying asset will decrease in value.

Consider finally the nature of a lawsuit. A lawsuit is also an investment in a contingent claim and shares the essential characteristics of a financial option.<sup>121</sup> It has counterparties,<sup>122</sup> a premium charged for the option in the form of litigation costs, a contingency

<sup>118</sup> See King, *supra* note 24, at 1378 (“A defendant’s tort not only destroys a ‘raffle ticket,’ in so doing it destroys any chance of ever knowing how that ticket would have fared in the drawing.”); Legum, *supra* note 29, at 568 (“It is as if courts are finding that 40% of all tickets in a lottery are absolutely worthless while 60% of the tickets are worth the entire prize.”). But see *Dumas v. Cooney*, 1 Cal. Rptr. 2d 584, 594 (Ct. App. 1991) (“[T]ort law should not operate by the same principles that govern lotteries and insurance policies.”). While the analogy is fair, a lottery ticket has positive value whereas an increased risk situation has negative value. A more accurate analogy is a game of Russian Roulette.

<sup>119</sup> Insurance has a long history. Ancient Egyptian, Hindu and Chinese societies used annuities. Lissa L. Broome & Jerry W. Markham, *Banking and Insurance: Before and After Gramm-Leach-Bliley Act*, 25 J. CORP. L. 723, 725 (2000). The Code of Hammurabi, which was enacted about 1800 B.C., devoted 282 clauses to “bottomry,” which was a loan taken out by a shipowner to finance voyages and which was nonpayable if the ship was lost. BERNSTEIN, *supra* note 41, at 92. Life insurance appeared in Europe between the 12th and 16th centuries. Broome & Markham, *supra*, at 725. In the 13th century, the Lombards introduced insurance to England. *Id.* The seeds of modern property and casualty insurance were sown in 1688 when Lloyd’s of London was formed at Edward Lloyd’s Coffee House for merchants to pool the risk of shipping in a syndicate. *Id.* at 725-26. See also BERNSTEIN, *supra* note 41, at 89-92 (sketching the historical beginnings of Lloyd’s of London); John Fabian Witt, *Towards a New History of American Accident Law: Classical Tort Law and the Cooperative First-Party Insurance Movement*, 114 HARV. L. REV. 692 (2001) (providing a history of the relationship between tort law and insurance).

<sup>120</sup> See BERNSTEIN, *supra* note 41, at 314 (“Options bear a strong family resemblance to insurance policies and are often bought and sold for the same reasons. Indeed, if insurance policies were converted into marketable securities, they would be priced in the marketplace exactly as options are priced.”).

<sup>121</sup> See Huang, *supra* note 115, at 1955 (“[A] lawsuit actually involves a series of call options.”). There has been much recent scholarly interest in applying option theory to analyze the economic value of lawsuits. *Id.* at 1953 n.48.

<sup>122</sup> The option analogy is complicated by the role of the attorney. Although a plaintiff owns the litigation option in theory, the attorney has a great deal of influence and power over the case in practice. See Charles W. Wolfram, *The Second Set of Players: Lawyers, Fee Shifting, and the Limits of Professional Discipline*, 47 LAW & CONTEMP. PROBS. 293, 296-97 (1984) (“Scholars who study the legal profession have been reporting for some time that

defined as a judgment of liability, and a maturity date defined as the entry of final judgment. The profit and loss characteristics of any given lawsuit for legal remedies behave similarly to a call option. The potential payout increases as the chances of winning increase, similar to the relationship between the current price and strike price of an option.<sup>123</sup>

### *E. The Common Understanding*

The foregoing discussion was not intended to be a thorough recitation of the subject of risk or financial economics.<sup>124</sup> It was written to place some ordinary concepts—investments in debt, equity and options—in the simple context of risk and value. Even the ancient world understood that risk has value and created primitive markets for risk trade. These markets continue today, although they have taken a more sophisticated form with the advent of quantitative methods.<sup>125</sup> In short, modern society understands, as did the ancients, that risk has value and that increased risk necessarily inflicts harm by creating negative value.

Nor is the notion of risk so esoteric, speculative or difficult a concept that it is beyond the ken of the average person who borrows money on credit cards, invests in stocks or bonds, buys lottery tickets, takes out insurance to protect his house or sues her employer for sexual harassment. The concepts of risk and reward drive most everyday decisions of individuals.<sup>126</sup> As Markowitz observed, everyone understands that unnecessary (or imposed) risk is a “bad thing.”<sup>127</sup> Most people are risk averse, particularly when it comes to potentially large losses, as evinced by the existence of the insurance industry.<sup>128</sup> There is no larger loss than

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lawyers regularly depart from the professional model of client control and make critical decisions on their own in . . . civil representations.”).

<sup>123</sup> Under this analogy, a settlement is an exercise of the option prior to maturity where the value has been privately negotiated between the counterparties. See Huang, *supra* note 115, at 1961-66 (analyzing the settlement value of lawsuits under option theory).

<sup>124</sup> A comprehensive discussion of the subject of risk can only be done in treatise or encyclopedic format. For an excellent, nontechnical discussion on the subject of risk, readers are referred to BERNSTEIN, *supra* note 41.

<sup>125</sup> See *id.* at 3 (“The modern conception of risk is rooted in the Hindu-Arabic numbering system that reached the West seven to eight hundred years ago.”).

<sup>126</sup> See DOUGLAS G. BAIRD ET AL., *GAME THEORY AND THE LAW* 11 (1994) (“Individuals are rational in the sense they consistently prefer outcomes with higher payoffs to those with lower payoffs.”).

<sup>127</sup> Markowitz, *supra* note 45, at 91.

<sup>128</sup> See *Price v. Marshall Erdman & Assoc.*, 966 F.2d 320, 327 (7th Cir. 1992) (“Risk-averse persons—and most people are assumed to be risk-averse in their serious financial affairs—will pay a premium, often a very large one, to avoid risk. That is the rationale of

one's life or health, which explains the enormous size of the life and health insurance market,<sup>129</sup> and a substantial risk to life or health is understood as harmful. Society expects that freedom from risk should be protected, and so the law mandates speed limits, workplace safety regulations, product safety standards, interstate transportation regulations, child endangerment laws and myriad other laws aimed at public safety. Tort law exists, in part at least, to deter costly and risky conduct.

Most persons, whether trained in finance or not, understand that in the hypothetical posed in Section I of this article, the defendant who negligently exposed the plaintiff to toxins has placed him in a worse situation by increasing her risk, and that this increased risk constitutes a present harm regardless of the specific level of that risk.<sup>130</sup> In the legal context, however, risk is not considered in such a simple light.

### III. RISK IN THE LEGAL CONTEXT

#### A. *The Traditional "All-or-Nothing" Rule*

The traditional rule, sometimes referred to as the all-or-nothing rule, is simply stated: if a plaintiff shows by a preponderance of the evidence that she would suffer a future injury, then she is compensated for the full present value of the future injury now; otherwise she recovers nothing.<sup>131</sup> The future predicted by a preponderance of the evidence is a "reasonable certainty" as to the present, the logic goes.<sup>132</sup> Most jurisdictions continue to use the all-or-nothing rule in increased risk cases.<sup>133</sup>

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insurance."); Stephen Penner, *International Investment and the Prudent Investor Rule: The Trustee's Duty to Consider International Investment Vehicles*, 16 MICH. J. INT'L L. 601, 626 (1995) ("This result is important because risk aversion is essentially universal. Most people are at least slightly risk averse.").

<sup>129</sup> In 2003, the global premium volume for all insurance was a staggering \$2.94 trillion, constituting 8.06 percent of the world GDP and \$469.6 of premium per capita. *World Insurance in 2003: Insurance Industry on the Road to Recovery*, Sigma No.3/2004, at 33 (Swiss Re Publication, June 1, 2004) (\$1.67 trillion for life and \$1.27 trillion for nonlife).

<sup>130</sup> See *supra* pages 114-15.

<sup>131</sup> See, e.g., *Wilson v. Johns-Manville Sales Corp.*, 684 F.2d 111, 119 (D.C. Cir. 1982).

<sup>132</sup> Various jurisdictions use different formulations: "in all likelihood," "reasonably certain," "reasonably probable," "medically probable," "probable," "reasonable medical certainty," and "more probable than not." Ashton, *supra* note 29, at 1103-05. All of these concepts refer to the same "but for" causation analysis required by the traditional rule. See Lapeze, *supra* note 29, at 254.

<sup>133</sup> Elert, *supra* note 29, at 691 (citing John D. Hodson, Annotation, *Medical Malpractice: "Loss of Chance" Causality*, 54 A.L.R. 4th 10, §§ 2, 4 (1987)).

The traditional rule is illustrated in *Sterling v. Velsicol Chemical Corp.*<sup>134</sup> Velsicol Chemical dumped 300,000 fifty-five gallon drums of toxins over a ten year period. These toxins infiltrated the local drinking water supply, and plaintiffs sued for increased risk of disease. The district court found that plaintiffs had a 25% to 30% increased risk of disease and awarded damages. But Tennessee law requires proof of a reasonable medical certainty that the anticipated harm will manifest by showing "probability—i.e., more than a fifty percent chance."<sup>135</sup> Thus, the Sixth Circuit rejected the increased risk theory of liability because the risk was "a mere possibility or speculation."<sup>136</sup>

The traditional rule is an extension of the well-accepted tort principle that an injured plaintiff may recover damages for an actual present injury as well as any related injury that is reasonably probable to occur.<sup>137</sup> Causation is the critical analysis,<sup>138</sup> and a plaintiff must prove both general and specific causation.<sup>139</sup> In toxic tort litigation, general causation is shown by producing scientific evidence from which a probabilistic inference can be made that the exposure was capable of causing the harm. Epidemiological evidence is commonly used to link the exposure and the harm.<sup>140</sup> Spe-

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<sup>134</sup> 855 F.2d 1188 (6th Cir. 1988).

<sup>135</sup> *Id.* at 1204-05 (citing *Maryland Cas. Co. v. Young*, 362 S.W.2d 241 (Tenn. 1962)); see also *Thompson v. Underwood*, 407 F.2d 994, 997 (6th Cir. 1969).

<sup>136</sup> *Sterling*, 855 F.2d at 1205; see also *Gideon v. Johns-Manville Sales Corp.*, 761 F.2d 1129, 1137-38 (5th Cir. 1985) ("[M]ere possibility does not meet the preponderance of the evidence standard. . . . [T]he plaintiff need demonstrate only that the event is more likely to occur than not.").

<sup>137</sup> See *Pullen v. Boston Elevated Ry. Co.*, 94 N.E. 469 (Mass. 1911); see also *Leslie*, *supra* note 9, at 1845.

<sup>138</sup> See *King*, *supra* note 17, at 499 ("A victim's claim is viewed exclusively in terms of causation.").

<sup>139</sup> See, e.g., *Merrell Dow Pharm., Inc. v. Havner*, 953 S.W.2d 706, 714-15 (Tex. 1997) (discussing general and specific causation) (citing Joseph Sanders, *From Science to Evidence: The Testimony on Causation in the Bendectin Cases*, 46 STAN. L. REV. 1, 14 (1993)).

<sup>140</sup> See Nancy Lee Firak, *The Developing Policy Characteristics of Cause-in-Fact: Alternative Forms of Liability, Epidemiological Proof and Trans-Scientific Issues*, 63 TEMP. L.Q. 311, 330 ("Epidemiological evidence shows a statistical relationship between the risk created by the defendant's conduct and the kind of injury suffered by the plaintiff, but it does not show a causal relationship between the two."); *Leslie*, *supra* note 9, at 1837 ("The strongest and most reliable evidence of general causation is a well-designed epidemiological study that shows an increased risk (against a background population) of harm from exposure to the drug or chemical."). See generally *Dore*, *supra* note 39; *Khristine L. Hall & Ellen K. Silbergeld, Reappraising Epidemiology: A Response to Mr. Dore*, 7 HARV. ENVTL. L. REV. 441 (1983); *Steve Gold, Note, Causation in Toxic Torts: Burdens of Proof, Standards of Persuasion, and Statistical Evidence*, 96 YALE L.J. 376 (1986). Epidemiological studies are expensive and many plaintiffs cannot afford them. *Leslie*, *supra* note 9, at 1841 (citing *Berger*, *supra* note 9, at 2128, and *Wendy E. Wagner, Choosing Ignorance in the*

cific causation is established by evidence that the toxic agent actually caused the injury.<sup>141</sup> In practice, causation is generally reduced to the “but for” standard.<sup>142</sup> Anything less than a showing of traditional causation is said to result in speculative damages.<sup>143</sup>

In increased risk cases, courts have struggled to find certainty in an area of the law where any evidence on probabilities will have a certain “best guess” quality at the margins.<sup>144</sup> Courts dogmatically have adhered to the 51% preponderance concept, stating it in such precise mathematical terms, as if expert testimonies between “equal chance” and “more likely than not” have any meaningful distinction in these cases beyond the artful. For example, testimony of a “fifty-fifty chance” has been held to be insufficient because an even chance is said to be a possibility and not a probability.<sup>145</sup> Courts have consistently stuck to this formalism,<sup>146</sup>

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*Manufacture of Toxic Products*, 82 CORNELL L. REV. 773, 774-75 (1997)). Additionally, they take a significant amount of time to conduct properly, and so plaintiffs may not have access to them even if they can afford the studies. *Id.* If epidemiological evidence is unavailable, other types of evidence can be used. See Berger, *supra* note 9, at 2123 (stating that plaintiffs generally rely on four kinds of evidence: structure-activity analysis, in vitro analysis, in vivo analysis, and epidemiological analysis).

Courts have taken various approaches to epidemiological evidence. Some courts have allowed epidemiological evidence where the relative risk, defined as “the ratio of the disease rate in those with the [causal] factor to the rate in those without,” is greater than one. See, e.g., *Landrigan v. Celotex Corp.*, 605 A.2d 1079, 1085, 1087 (N.J. 1992) (study of relative risk of 1.55 was “one piece of evidence, among others, for the court to consider in determining whether the expert has employed a sound methodology in reaching his or her conclusion”). Other courts have required a relative risk of greater than two. See, e.g., *DeLuca v. Merrell Dow Pharm., Inc.*, 911 F.2d 941, 958 (3d Cir. 1990) (holding that a plaintiff who relies solely on epidemiological evidence to survive summary judgment must establish a relative risk greater than 2.). Still others have rejected other scientific evidence if epidemiological evidence was missing. See, e.g., *Moore v. Ashland Chem., Inc.*, 151 F.3d 269, 282, 286 (5th Cir. 1998) (Dennis, J., dissenting) (noting majority’s rejection of clinical evidence where not supported by epidemiological data).

<sup>141</sup> Berger, *supra* note 9, at 2122. Causation is difficult to prove because there often is no direct proof, and the evidence is inferential and often based on an incomplete understanding of the underlying biological and chemical processes. *Id.* at 2120-21.

<sup>142</sup> See *Havner*, 953 S.W.2d at 715 (adopting the preponderance standard); *Daubert v. Merrell Dow Pharm. Inc.*, 43 F.3d 1311, 1320 (9th Cir. 1995) (same).

<sup>143</sup> See, e.g., *Crawford v. Seufert*, 388 P.2d 456, 459 (Or. 1964) (“If the probabilities are in balance, the matter is left to speculation. Speculation filtered through a jury is still speculation.”).

<sup>144</sup> See Berger, *supra* note 9, at 2129 (“[T]he scientific evidence relied on to prove causation is subject to numerous kinds of uncertainty.”).

<sup>145</sup> *Davis v. P. Gambardella & Son Cheese Corp.*, 161 A.2d 583, 587 (Conn. 1960), *overruled by* *Petriello v. Kalman*, 576 A.2d 474 (Conn. 1990).

<sup>146</sup> See *Healy v. White*, 378 A.2d 540, 544 (Conn. 1977), *overruled by* *Petriello*, 576 A.2d 474. Other courts have held similarly. See, e.g., *Devine v. S. Pac. Co.*, 295 P.2d 201, 272 (Or. 1956) (distinguishing between evidence establishing mere “possibility” and “probability”); *Russell v. Subbiah*, 500 N.E.2d 138, 141 (Ill. App. Ct. 1986) (holding that



which creates an illusory legal certainty in cases that inherently concern the uncertain.

The evidentiary hurdle is daunting for a plaintiff.<sup>147</sup> Most cases involve a significant increase in the risk of harm though not to levels that exceed the evidentiary burdens.<sup>148</sup> We recognize that even a 10% increase in risk of death is a great harm. Would any rational person exchange a 10% risk of death for \$10,000? Yet many lawsuits are brought for damages for less than \$10,000 or for other relatively trivial interests. Although the adherence to traditional concepts of causation and evidentiary burdens is purportedly neutral in principle, its practical import is that virtually all claims for increased risk are precluded because most harmful exposures to toxins, however noxious, simply do not cross the legal Rubicon that is the preponderance rule.

Criticism of the traditional rule has been legion. While most of the criticism has focused on the weighty policy concerns,<sup>149</sup> commentators have also noted two practical problems associated with administering the rule.

First, statutes of limitations are a problem because if a plaintiff cannot meet the preponderance burden she must wait until the injury manifests.<sup>150</sup> The plaintiff is then caught in a Catch-22 situation: she must wait for the injury to occur, but the process of wait-

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fifty-fifty chance of future injury failed to meet reasonable certainty standard); *Cooper v. Sisters of Charity of Cincinnati, Inc.*, 272 N.E.2d 97, 104 (Ohio 1971) ("Probability is most often defined as that which is more likely than not."); *overruled by* *Roberts v. Ohio Permanente Med. Group, Inc.*, 668 N.E.2d 480 (Ohio 1996); *Fennell v. Southern Maryland Hosp. Ctr., Inc.*, 580 A.2d 206, 214 (Md. 1990) (distinguishing between forty-nine and fifty-one percent chance); *see also* Schmauder, *supra* note 29, at 897 n.19 (citing other cases adhering to 51-49 distinction).

<sup>147</sup> Most cases simply do not present the extreme increases in risk required by the traditional rule. *See* McDonnell, *supra* note 29, at 632 ("Most toxic tort plaintiffs are precluded [because] . . . the probability of the plaintiff actually developing the disease usually is less than fifty percent."); Klein, *supra* note 9, at 1179 ("[The traditional rule] represents a nearly insurmountable barrier for enhanced risk plaintiffs."); Love, *supra* note 29, at 809 (noting that increased risk cases face the highest barrier to recovery); *see also* Sterling v. Velsicol Chem. Corp., 855 F.2d 1188, 1205 (6th Cir. 1988); *Anderson v. W.R. Grace & Co.*, 628 F. Supp. 1219, 1232 (D. Mass. 1986).

<sup>148</sup> *See* Sterling, 855 F.2d at 1204-05; *Dartez v. Fibreboard Corp.*, 765 F.2d 458, 466 (5th Cir. 1985); *Anderson*, 628 F. Supp. at 1232; *Ayers v. Jackson Township*, 525 A.2d 287, 308 (N.J. 1987). *See also* McDonnell, *supra* note 29, at 633 (noting only two reported cases where plaintiffs successfully recovered for increased risk: *Jackson v. Johns-Manville Sales Corp.*, 781 F.2d 394, 411 (5th Cir. 1986) (asbestos case), and *Gideon v. Johns-Manville Sales Corp.*, 761 F.2d 1129, 1138 (5th Cir. 1985) (same)).

<sup>149</sup> *See supra* notes 24-29 and accompanying text.

<sup>150</sup> Lapeze, *supra* note 29, at 257; Lisa Heinzerling & Cameron Powers Hoffman, *Tortious Toxics*, 26 WM. & MARY ENVTL. L. & POL'Y REV. 67, 74 (2001).

ing may result in the preclusion of the claim.<sup>151</sup> Addressing this problem, some jurisdictions have adopted the so-called discovery rule, which tolls the statute of limitations until the plaintiff knows or should have known of the injury.<sup>152</sup> But the discovery rule is not a complete tonic.<sup>153</sup> For one thing, it is inapplicable if there is a current injury accompanying the increased risk.<sup>154</sup> Moreover, many injury situations are not clear cut as to the existence of an injury and the extent of that injury. Finally, there is the issue of whether discovery occurs on the date of the exposure, the date the plaintiff knew of the defendant's wrongful conduct, the date of any microscopic or cellular change, or the date of manifestations of the disease.<sup>155</sup> A statute of limitations should be unambiguous because it deals with preclusion of claims, but in this field the lack of clarity poses a significant trap for the unwary plaintiff.<sup>156</sup> The application of a statute of limitations and the discovery rule has the potential

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<sup>151</sup> Klein, *supra* note 9, at 1181; McDonnell, *supra* note 29, at 624, 629-30.

<sup>152</sup> Historically, the discovery rule has been used in cases involving fraud, mistake and breach of fiduciary duty. *Developments in the law—Statute of Limitations*, 63 HARV. L. REV. 1177, 1221-22 (1950). The discovery rule has since been extended to other types of cases. See Annotations, *When Statute of Limitations Commences to Run Against Malpractice Action Against Physician, Surgeon, Dentist, or Similar Practitioner*, 80 A.L.R.2d 368, 387 (1961), 79-80 A.L.R.2d 472, 511 (Supp. 2000). In passing the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Congress tolled all state statutes of limitations for exposure to a hazardous substance or pollutant released into the environment from a facility until "the plaintiff knew (or reasonably should have known)" of the injury. 42 U.S.C. § 9658 (2004).

<sup>153</sup> See Klein, *supra* note 9, at 1183 (arguing that the discovery rule and splitting causes of action "raise more problems than they solve").

<sup>154</sup> See, e.g., *Albertson v. T.J. Stevenson & Co.*, 749 F.2d 223 (5th Cir. 1984); *Hagerty v. L&L Marine Servs., Inc.*, 788 F.2d 315 (5th Cir. 1986); see also Elert, *supra* note 29, at 703 ("If the plaintiff has already suffered a recoverable injury . . . , the [discovery rule] will be inconsequential because first, the plaintiff is most likely aware at the time of the original injury of other possible future consequences, and second, if the plaintiff attempts to recover for the original injury, the claim for future injuries will be barred under the theory of res judicata."); Lapeze, *supra* note 29, at 258.

<sup>155</sup> See *Raymond v. Eli Lilly & Co.*, 371 A.2d 170, 176-77 (N.H. 1977) (discussing the issues pertaining to the application of the discovery rule); see also Klein, *supra* note 9, at 1183 ("Is it the date of exposure? The date of 'sub-cellular injury'? The date when the plaintiff discovers the defendant's legal responsibility? Or do we wait until manifestation of disease before starting the clock?"); Lapeze, *supra* note 29, at 258 ("In practice, the main problem with the discovery rule is determining when the plaintiff knew or should have known when an injury occurs to 'trigger' prescription.").

<sup>156</sup> See, e.g., *Albertson*, 749 F.2d at 231 (holding that plaintiff who lost consciousness and experienced severe headaches after exposure to a toxin was time barred when he filed suit several years later because the statute of limitations started to accrue after he lost consciousness).

for creating satellite litigation within the lawsuit, as is often the case whenever the statute of limitations is at issue.<sup>157</sup>

Second, the doctrines of res judicata and merger present significant practical problems. A plaintiff could have a current injury from the accident, the manifestation of which may be trivial or relatively minor, and a substantial chance of a future injury, which is anticipated to be far more severe.<sup>158</sup> He is then aware of the injury and so should file a lawsuit, even if the jurisdiction has a discovery rule. But if the plaintiff cannot prove the future injury under the traditional rule, and the risk subsequently manifests into a physical injury, under res judicata and merger doctrines he cannot file another lawsuit.<sup>159</sup> This presents a plaintiff with a devil's choice: sue now and waive future claims, or sue later and waive present claims.<sup>160</sup> Further complicating the matter is the interplay of any applicable statute of limitations on a later action. Recognizing this fundamental unfairness, some jurisdictions have allowed a plaintiff to split her cause of action into an action for an injury or manifestation incurred in the present and a future action for latent inju-

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<sup>157</sup> See *infra* Section VII.B (discussing the efficiency of eliminating the statute of limitations in the context of increased risk cases).

<sup>158</sup> See, e.g., *Albertson*, 749 F.2d at 223.

<sup>159</sup> See RESTATEMENT (SECOND) OF JUDGMENTS § 24 (1982) (stating that the rule of merger bars plaintiff from bringing a subsequent claim arising out of same transaction upon final judgment of remedy in an action); BLACK'S LAW DICTIONARY 1305 (8th ed. 2004) (defining res judicata "barring the same parties from litigating a second lawsuit on the same claim . . . raised in the first suit"). Res judicata has long been observed in tort claims to preclude successive lawsuits, though more and better information has come out. See *Dillon v. Evanston Hosp.*, 771 N.E.2d 357, 368 (Ill. 2002) (quoting *Petriello v. Kalman*, 576 A.2d 474, 483 (Conn. 1990)); *Howell v. Goodrich*, 69 Ill. 556, 559-60 (1873) ("[T]here can not be successive suits brought from time to time, as damages may in the future be suffered, but the recovery is once for all, and may embrace prospective as well as accrued damages."); *DOBBS*, *supra* note 91, § 3.1, at 208 ("The damages remedy is not conditional, and it is not payable periodically as loss accrues unless a statute so provides. So the damages award is traditionally made once, in a lump sum to compensate for all the relevant injuries, past and future."); *McDonnell*, *supra* note 29, at 628 ("Cases involving both a present injury and an increasing likelihood of a future disease or injury present a problem for the plaintiff because the rules of res judicata usually limit an injured party to one recovery.").

<sup>160</sup> See *Hagerty v. L&L Marine Servs., Inc.*, 788 F.2d 315, 320 (5th Cir. 1986) ("The victim of exposure to toxic substances which cause present harm and which may at some future time cause cancer or other serious disease is further victimized by the single cause of action rule."); *Klein*, *supra* note 9, at 1181-82 (explaining Catch-22 situation posed by the traditional rule); *Bill Charles Wells, The Grin Without the Cat: Claims for Damages from Toxic Exposure Without Present Injury*, 18 WM. & MARY J. ENVTL. L. 285 (1994) ("[T]he potential plaintiff is faced with a choice between an inadequate recovery if he sues immediately, and no recovery if he waits.").

ries.<sup>161</sup> Other jurisdictions have indirectly addressed the problem by recognizing other causes of action as avenues for partial remedy, the two principal actions being for fear of future disease<sup>162</sup> and recovery of future medical monitoring costs.<sup>163</sup> These are independent causes of action arising out of the transaction that precipitated the increased risk, but are not actions to remedy the harm resulting from the increased risk itself.<sup>164</sup>

The traditional rule presents significant practical problems implicating procedural fairness, predictability and the uniform administration of justice. Despite a clear consensus among courts that freedom from increased risk is not an independent interest worthy of legal protection, the procedural administration of the traditional rule has been anything but uniform or predictable. Courts have recognized the inherent unfairness of the legal regime, at least in some of its procedural and evidentiary applications, and have employed various measures to alleviate some of its harshness. But this approach has been aptly described as “patchwork.”<sup>165</sup>

<sup>161</sup> See Elert, *supra* note 29, at 703-04; see also RESTATEMENT (SECOND) OF JUDGMENTS § 26 (advocating a splitting of the cause of action in an increased risk situation).

<sup>162</sup> These are essentially claims for negligent infliction of emotional distress that have been specially recognized outside the ordinary rules applicable to this field. See, e.g., Potter v. Firestone Tire & Rubber Co., 863 P.2d 795, 824 (Cal. 1993) (fear of disease); Herbert v. Regents of Univ. of Cal., 31 Cal. Rptr. 2d 709 (Cal. Ct. App. 1994) (AIDS phobia); Ferrara v. Galluchio, 152 N.E.2d 249, 251-52 (N.Y. 1958) (cancerphobia). See generally Andrew R. Klein, *Fear of Disease and the Puzzle of Future Cases in Tort*, 35 U.C. DAVIS L. REV. 965 (2002); Glen Donath, Comment, *Curing Cancerphobia: Reasonableness Redefined*, 62 U. CHI. L. REV. 1113 (1995).

<sup>163</sup> See, e.g., Ayers v. Jackson Township, 525 A.2d 287, 312-13 (N.J. 1987) (recovery for future medical surveillance to detect signs of cancer on theory that the medical expenses could be construed as presently identifiable injury); Paoli R.R. Yard PCB v. Monsanto Co., 916 F.2d 829, 850 (3d Cir. 1990) (“Nonetheless, in an effort to accommodate a society with an increasing awareness of the danger and potential injury caused by the widespread use of toxic substances, courts have begun to recognize claims like medical monitoring, which can allow plaintiffs some relief even absent present manifestations of physical injury.”); Potter, 863 P.2d at 824 (“It bears emphasizing that allowing compensation for medical monitoring costs ‘does not require courts to speculate about the probability of future injury. It merely requires courts to ascertain the probability that the far less costly remedy of medical supervision is appropriate.’” (quoting Paoli, 916 F.2d at 852)). See generally Andrew R. Klein, *Rethinking Medical Monitoring*, 64 BROOK. L. REV. 1 (1998); Kara L. McCall, Comment, *Medical Monitoring Plaintiffs and Subsequent Claims for Disease*, 66 U. CHI. L. REV. 969 (1999).

<sup>164</sup> It is beyond the scope of this article to discuss in detail these derivative actions. I note that while fear of disease and future medical monitoring may be compensable harms, they simply do not address the fundamental injury from which these harms arise—increased risk of bodily injury. Nevertheless, these causes are palatable to the law because the interests (mental distress and economic harm) fall squarely into the conventional scheme.

<sup>165</sup> Klein, *supra* note 9, at 1182.

### B. The Loss of Chance Doctrine

The judicial treatment of risk is also seen in the loss of chance doctrine. Whereas increased risk deals with a presumably healthy plaintiff incurring increased risk of a future harm, and arises primarily in the context of a toxic tort exposure situation, loss of chance deals with a plaintiff with a preexisting illness who loses the chance to recover from the illness due to a defendant's medical malpractice.<sup>166</sup> Although the two doctrines are mirror images in terms of risk,<sup>167</sup> they developed differently.<sup>168</sup>

Courts have perceived the nature of the risk differently in the two doctrines.<sup>169</sup> In a loss of chance case, the plaintiff must show by a preponderance of the evidence that he lost a chance for a favorable outcome, and this loss of chance is attributable to the defendant.<sup>170</sup> A plaintiff need not prove that she would have enjoyed a greater than 50% chance of survival or recovery absent

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<sup>166</sup> See generally Julie A. Braun & Maria Elyse Rabar, *Recent Developments in Medicine and Law*, 36 TORT & INS. L.J. 463 (2001). One noteworthy distinction between the two is that loss of chance typically involves risk of death, where increased risk can deal with any risk of bodily harm. Elert, *supra* note 29, at 715.

<sup>167</sup> "Tortious exposure to risk is in fact really the obverse of these 'losses of chance' cases, and the problems of causal determination and valuation are virtually identical." Robinson, *supra* note 25, at 792-93. See also Love, *supra* note 29, at 818-19 (noting similarities between the two doctrines).

<sup>168</sup> Unlike the traditional rule for increased risk, the loss of chance doctrine is a newer concept. The traditional rule of increased risk has long been established. See *Amann v. Chicago Consol. Traction Co.*, 90 N.E. 673, 674 (Ill. 1909) ("To justify a recovery for future damages the law requires proof of a reasonable certainty that they will be endured in the future."). The loss of chance doctrine is generally attributable to *Hicks v. United States*, 368 F.2d 626 (4th Cir. 1966). Jason Perkins, Note, *McMullen v. Ohio State Hospitals: Legal Recovery for Terminally Ill and Injured Patients Without the Loss Chance Doctrine*, 32 U. TOL. L. REV. 451, 453 (2001). In *Hicks*, the decedent died from intestinal blockage, which plaintiff alleged was misdiagnosed by the Navy doctor. The Fourth Circuit reversed a dismissal of the complaint, reasoning that "[i]f there was any substantial possibility of survival and the defendant has destroyed it, he is answerable." 368 F.2d at 632. The substantial possibility standard was a deviation from the preponderance of the evidence standard. But King notes that this language was dictum since expert testimony established that the decedent "would have survived." King, *supra* note 24, at 1369 n.53. About half the jurisdictions recognize a loss of chance cause of action. These jurisdictions include Alabama, Arizona, Arkansas, California, Colorado, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Louisiana, Montana, New Jersey, New York, Nevada, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Washington, West Virginia, and Wisconsin. Elert, *supra* note 29, at 710-11.

<sup>169</sup> See *United States v. Anderson*, 669 A.2d 73, 75-76 (Del. 1995) (discussing the differences between increased risk and loss of chance doctrine).

<sup>170</sup> See, e.g., *Jorgenson v. Vener*, 616 N.W.2d 366, 370-71 (S.D. 2000) (attributing this two-part analysis to King, *supra* note 24, at 1370).

the negligence.<sup>171</sup> The risk is taken at face value as a *measure* of the injury rather than evidence of injury, so damages are calculated by multiplying the lost opportunity by the present value of the total damages should the plaintiff fail to recover.<sup>172</sup> For example, if a plaintiff's chance of recovery from cancer was reduced by 10% due to a negligent misdiagnosis and death from cancer is valued at \$100, then the recoverable damage would be \$10.<sup>173</sup> Under traditional causation analysis, the plaintiff should recover nothing since it is more likely than not that she would die of cancer regardless of the malpractice. This deviation from the way the law deals with risk has been attributed to a policy of promoting proper standards of medical care by not allowing health care providers to escape liability for negligence.<sup>174</sup> To serve this end, courts have distinguished the physical injury from the loss of chance.<sup>175</sup>

<sup>171</sup> See, e.g., *Holton v. Memorial Hospital*, 679 N.E.2d 1202, 1213 (Ill. 1997) (holding that loss of chance doctrine applies where pre-malpractice probability of recovery is less than fifty percent); *Estate of Donnini v. Ouano*, 810 P.2d 1163 (Kan. Ct. App. 1991) (same). The theoretical basis for this proportional recovery scheme is generally attributable to King, *supra* note 24, at 1370.

<sup>172</sup> See, e.g., *Perez v. Las Vegas Med. Ctr.*, 805 P.2d 589, 592 (Nev. 1991) (applying proportional damages based on lost chance attributable to negligence).

<sup>173</sup> If malpractice decreased a loss of chance of recovery from 28% to 20%, a net 8% loss of chance of recovering from a preexisting illness, and the plaintiff subsequently dies (i.e., the plaintiff is one of the unfortunate 80% of the people who do not survive), then the cause in fact attributable to the death is 90% the preexisting illness and 10% the loss of chance attributable to the malpractice. Although traditional causation under the preponderance test cannot be satisfied, the plaintiff can still recover for the percent loss of chance.

This is not to suggest that traditional causation can never be shown where the chance of death is less than 50%. The inquiry is not the absolute chance of death, but the causality of that death. For instance, assume a person had a 90% chance of recovery, but a doctor's negligence reduced this chance to 75%. If the patient dies, the inquiry is not whether the doctor's negligence made the chance of death more likely than not, but whether the death was more likely than not caused by the negligence. Without the negligence, the chance of death was 10%. With the negligence, it is 25%. Death in fact occurred, and the law must determine what caused the death. We conclude that 60% is attributable to the negligence and 40% is attributed to other causes. Thus traditional causation is satisfied.

<sup>174</sup> See, e.g., *Holton*, 679 N.E.2d at 1213 ("Disallowing tort recovery in medical malpractice actions on the theory that a patient was already too ill to survive or recover may operate as a disincentive on the part of health care providers to administer quality medical care to critically ill or injured patients."); *Herskovits v. Group Health Cooperative of Puget Sound*, 664 P.2d 474, 477 (Wash. 1983) ("To decide otherwise would be a blanket release from liability for doctors and hospitals any time there was less than a fifty percent chance of survival, regardless of how flagrant the negligence.").

<sup>175</sup> *Herskovits*, 664 P.2d at 481 (Pearson, J., concurring) ("If the injury is determined to be the death of Mr. Herskovits, then under the established principles of proximate cause plaintiff has failed to make a prima facie case. . . . If, on the other hand, we view the injury to be the reduction of Mr. Herskovits' chance of survival, our analysis might well be different.").

### C. The Minority "Proportionality" Rule

Due to the evident harshness of the all-or-nothing rule, some courts have haphazardly relaxed the evidentiary and causation hurdles in the interest of doing substantial justice.<sup>176</sup> By contrast, a small minority of cases have allowed recovery for increased risk though the risk is less than a preponderance (for convenience, the minority rule is referred to as the "proportionality" rule). Although various courts have at one time or another allowed these claims,<sup>177</sup> only a few state supreme courts have explicitly rejected the traditional rule in favor of the proportionality rule.

Connecticut was one of the first jurisdictions affirmatively to reject the traditional rule in a limited context. In *Petriello v. Kalman*, the plaintiff underwent a surgical procedure to remove a dead fetus. During surgery the defendant perforated the uterus and drew portions of the plaintiff's small intestine.<sup>178</sup> As a result, defendant had to excise one foot of small intestine. At trial, one expert testified that there was a "very remote" chance of future intestinal obstruction, while another calculated the risk at 8% to 16%.<sup>179</sup> The court held that the plaintiff should recover proportionally the possibility of her future injury to "the extent of her present injuries."<sup>180</sup> A close reading of the opinion shows a tension between the holding and the reasons supporting it. Read strictly, the opinion suggests that a plaintiff can seek proportional damage for the future consequences of a present physical injury.<sup>181</sup> In

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<sup>176</sup> See Love, *supra* note 29, at 817-18 (discussing cases); *infra* Section V.E (discussing the market share theory of liability).

<sup>177</sup> The following jurisdictions have at one point or another allowed such claims: California, Delaware, Florida, Illinois, Iowa, Kentucky, Louisiana, Michigan, Missouri, New Jersey, Oregon, Pennsylvania and Virginia. See Elert, *supra* note 29, at 713-14 n.160 (citing cases from these jurisdictions); Legum, *supra* note 29, at 569-70 (listing other cases).

<sup>178</sup> 576 A.2d 474, 476-77 (Conn. 1990).

<sup>179</sup> *Id.* at 481.

<sup>180</sup> *Id.* at 483. "[I]n a tort action, a plaintiff who has established a breach of duty that was a substantial factor in causing a *present injury* which has resulted in an increased risk of future harm is entitled to compensation to the extent that the future harm is likely to occur." *Id.* at 484 (emphasis added).

<sup>181</sup> This conclusion is supported by the distinction drawn between an *injury* and its future *consequences*:

This system is inconsistent with the goal of compensating tort victims fairly for all the *consequences* of the *injuries* they have sustained, while avoiding, so far as possible, windfall awards for consequences that never happened. . . . Similar evidence, based upon medical statistics of the average incidence of a particular future *consequence* from an *injury*, such as that produced by the plaintiff in this case, may be said to establish with the same degree of certitude the likelihood of the occurrence of the future harm to which a tort victim is exposed as a result of a *present injury*.

other words, the increased risk was a parasitic aggravation of damages for a present injury,<sup>182</sup> reminiscent of the early and now obsolete treatment of negligent infliction of emotional distress claims.<sup>183</sup> Yet the court's reasoning was more expansive. The proportionality rule is fairer because it prevents over- and under-compensation, and a plaintiff "should not be burdened with proving that the occurrence of a future event is more likely than not, when it is a present risk, rather than a future event for which she claims damages."<sup>184</sup> This passage reveals the true interests at stake.<sup>185</sup> Under the *Petriello* rationale, it remains to be seen whether a pure increased risk without a present physical injury is an independent tort or whether such an interest must be anchored to a present physical injury.<sup>186</sup>

In *Dillon v. Evanston Hospital*, Illinois followed Connecticut's lead.<sup>187</sup> The plaintiff averred that the defendant doctor negligently left a piece of catheter, which later lodged in her heart.<sup>188</sup> The increased risk of future medical complications included infection, perforation, arrhythmia, embolization and further migration of the fragment into the heart.<sup>189</sup> Evidence at trial showed a 0% to 20%

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*Id.* at 483, 484 (emphasis added).

<sup>182</sup> Other courts have connected present injuries and the future consequences of those injuries. See, e.g., *Fabio v. Bellomo*, 504 N.W.2d 758, 763 (Minn. 1993) (allowing recovery for "future effects flowed directly from the initial injuries . . . [if] proven with reasonable medical certainty"). The reasoning in these decisions is consistent with the traditional rule that a plaintiff is entitled to compensation for all reasonable consequences of an injury. See, e.g., *Pullen v. Boston Elevated R.R. Co.*, 94 N.E. 469 (Mass. 1911).

<sup>183</sup> See PROSSER & KEETON, *supra* note 1, § 54, at 363 ("With a cause of action established by the physical harm, 'parasitic' damages are awarded, and it is considered that there is sufficient assurance that the mental injury is not feigned."). Even in the law of negligent infliction of emotional distress, which is one of the most controversial and fractured in torts, the notion of a "parasitic" injury has long since been dispensed with. See, e.g., *Dillon v. Legg*, 441 P.2d 912, 924 (Cal. 1968) (adopting the bystander rule); *Spade v. Lynn & Boston R. Co.*, 47 N.E. 88 (Mass. 1897) (adopting the physical impact rule), *overruled by* *Dziokonski v. Babineau*, 380 N.E.2d 1295 (Mass. 1978); *Waube v. Warrington*, 258 N.W. 497 (Wis. 1935) (adopting the zone of danger test), *overruled by* *Bowen v. Lumbermens Mut. Cas. Co.*, 517 N.W.2d 432 (Wis. 1994).

<sup>184</sup> *Petriello*, 576 A.2d at 483 (emphasis added).

<sup>185</sup> *Id.* at 484. As a result of this decision, Connecticut promulgated new jury instructions: "The plaintiff is entitled to compensation to the extent that the future harm is likely to occur as measured by multiplying the total compensation to which the plaintiff would be entitled if the harm in question were certain to occur by the proven probability that the harm in question will in fact occur." Connecticut Civil Jury Instruction No. 2-40(c).

<sup>186</sup> See Klein, *supra* note 9, at 1179 (noting that the traditional rule requires some form of a present physical injury).

<sup>187</sup> 771 N.E.2d 357 (Ill. 2002).

<sup>188</sup> *Id.* at 361.

<sup>189</sup> *Id.* at 366.



risk for infection, less than a 5% risk for arrhythmia, and a negligible risk for other conditions.<sup>190</sup> The Illinois Supreme Court overruled earlier decisions that had established the traditional rule.<sup>191</sup> The court dismissed the notion that awarding damages would be speculative, reasoning that scientific advances have enabled the medical community to determine the probability of future injuries more accurately.<sup>192</sup> It held that a "plaintiff can obtain compensation for a future injury that is not reasonably certain to occur, but the compensation would reflect the low probability of occurrence."<sup>193</sup>

Both the *Petriello* and *Dillon* courts found support for the proportionality rule in fundamental fairness.<sup>194</sup> Two of the basic goals of tort law are to correct the wrong done to the plaintiff by putting him back in nearly the same position as before the accident and to deter future accidents by imposing civil sanctions.<sup>195</sup> Both courts recognized that a proportionality rule achieves these goals better than the traditional rule. But both decisions arose in the context of claims for medical malpractice also involving some present physical injuries. As discussed, courts have viewed medical malpractice cases differently from toxic tort cases.<sup>196</sup> The recognition of proportional increased risk claims in these cases may be an extension of the special policies underlying the loss of chance doctrine. Also, both cases involved present physical injuries, and it could be argued that the courts viewed the award of remedies for increased risk as a logical extension of damages awards for the present physical injuries. However, despite the expansive reasoning of *Petriello* and *Dillon*, they are easily distinguishable from most toxic torts, which involve latent risk of harm rather than a discernable present physical injury. At present, no jurisdiction has unequivocally adopted the proportionality rule outside of the medical malpractice

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<sup>190</sup> *Id.*

<sup>191</sup> *Id.* at 370 (overruling *Amann v. Chicago Consolidated Traction Co.*, 90 N.E. 673 (Ill. 1909), and *Stevens v. Illinois Central R.R. Co.*, 137 N.E. 859 (Ill. 1922)).

<sup>192</sup> *Id.*

<sup>193</sup> *Id.* The court then endorsed the Connecticut jury instruction, *supra* note 185, as a correct statement of the law. *Id.* at 372.

<sup>194</sup> *Id.* at 370 ("Fairness requires that this court speak to this issue definitively."); *Petriello v. Kalman*, 576 A.2d 474, 483 (Conn. 1990) ("[The traditional rule] is inconsistent with the goal of compensating tort victims fairly for all the consequences of the injuries they have sustained . . .").

<sup>195</sup> See *DePass v. United States*, 721 F.2d 203, 210 (7th Cir. 1983) (Posner, J., dissenting); *Mauro v. Raymark Indus. Inc.*, 561 A.2d 257, 269-70 (N.J. 1989) (Handler, J., dissenting).

<sup>196</sup> See *infra* Section III.B.

context and without some manifestation of a present physical injury.

#### IV. CRITICISM AND POLICY CONSIDERATIONS

##### A. *The Legal Fiction of Injury and Causation*

A striking feature of the all-or-nothing rule is the use of a legal fiction under the guise of applying traditional principles of tort law. The rule redefines the concept of risk by creating a bright line division between “possibility” and “probability,” and based on this division assumes the nonexistence or existence of an injury. It assumes that a future harm proven to a “reasonable certainty” is a present actuality, and therefore the injury is a physical harm.<sup>197</sup> On the one hand, this approach purports to apply the established concept that a claim should seek recovery of damages for an actual injury and any related injury reasonably probable to occur.<sup>198</sup> On the other hand, the irrationality of this approach is patent, for any future injury is an unknown contingency.<sup>199</sup>

Once the law takes the plunge into predicting the future and assigning a value to that contingency, the concept of injury is really just a probability function.<sup>200</sup> Thus, there is no reason why damages for such an injury should not be assessed in accordance with the degree of that probability function, similar to the way the legal system would mete out differing amounts of damages for a broken finger, a ruptured kidney and death. The inquiry should not focus on the “reasonable certainty” of a future occurrence, which is always a speculative endeavor,<sup>201</sup> but on the severity of the injury

<sup>197</sup> See, e.g., *Amann v. Chicago Consol. Traction Co.*, 90 N.E. 673, 674 (Ill. 1909), *overruled by* *Dillon*, 771 N.E.2d 357.

<sup>198</sup> See *supra* note 137 and accompanying text.

<sup>199</sup> In most personal injury cases, the injury can be established with factual certainty through empirical testing. This is the key distinction between negligence actions for physical and mental injuries, and the reason why claims for negligent infliction of emotional distress have been so controversial and have not been analyzed under traditional tort rules. See generally Robert J. Rhee, *A Principled Solution for Negligent Infliction of Emotional Distress Claims*, 36 ARIZ. ST. L.J. \_\_\_\_ (2004).

<sup>200</sup> See Robinson, *supra* note 25, at 787 (endorsing proportional recovery); King, *supra* note 24, at 1382 (same). But see Wright, *supra* note 29, at 578 (stating that the substitution of mathematical functions for the causation requirement under the proportionality rule does not constitute “scientific progress”).

<sup>201</sup> Here the term *speculative* is used loosely in the sense that the future will never be known for certain. Strictly speaking, to speculate means to act “on the basis of insufficient evidence.” WEBSTER’S NINTH NEW COLLEGIATE DICTIONARY 1133 (1985). This is the common usage in the financial markets, which distinguish between speculation and investment. Uncertainty should not be a basis to preclude all claims. Even the traditional rule does not go this far. If the risk or uncertainty can be quantified, the matter is not specula-

based on a quantitative assessment of the risk. In other words, it is a matter of valuation of damages and not of assignment of liability.<sup>202</sup>

Under the traditional rule, if two plaintiffs are similarly exposed and both recover damages, a possibility exists that one plaintiff will eventually suffer the physical injury while the other never will. This anomaly can result because a statistical concept of injury is a proxy for the certainty of a physical injury. If physical injury is the true injury for which a remedy is provided, it would be far better to toll the statute of limitations until injury manifests. This would impose significant litigation costs on the plaintiff in the form of lost or stale evidence and the potential disappearance of the defendant through corporate dissolution, merger or liquidation.<sup>203</sup> These costs, atypical in most ordinary cases, would increase the plaintiff's litigation risk.<sup>204</sup> Nevertheless, if a certainty of physical injury is the concern, requiring a manifestation would be truer to tort principles and would be far more just to the defendant, who would be held liable only upon a showing of actual physical injury.<sup>205</sup> The injury for which the traditional rule provides remedy is a legal fiction; and it matters not whether the future injury is characterized as a "reasonable certainty."<sup>206</sup>

The traditional rule is justified primarily on causation grounds. In toxic tort litigation, the key issue is causation.<sup>207</sup> A plaintiff

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tion in the irrational sense. In this regard, the difference between the traditional rule and the approach suggested here is only a matter of degree.

<sup>202</sup> King first raised this insight. See King, *supra* note 24, at 1354-55 (distinguishing issue of liability from damage valuation in proposing the proportionality rule).

<sup>203</sup> See Ash, *supra* note 29, at 1094-95 (noting problems for delayed lawsuits); Lapeze, *supra* note 29, at 251 (noting the problem of bankruptcy, liquidation or death); Love, *supra* note 29, at 802-03 ("[B]y the time a disease manifests itself, a particular company may have reorganized, gone out of business, or declared bankruptcy.").

<sup>204</sup> See *infra* pages 161-63 (discussing litigation risks).

<sup>205</sup> Cf. Schweitzer v. Consol. Rail Corp., 758 F.2d 936, 942 (3d Cir. 1985) ("Requiring manifest injury as a necessary element of an asbestos-related tort action avoids these problems [of speculative damages] and best serves the underlying purpose of tort law.").

<sup>206</sup> See, e.g., Amann v. Chicago Consol. Traction Co., 90 N.E. 673, 674 (Ill. 1909) ("reasonable certainty" standard); Russell v. Subbiah, 500 N.E.2d 138, 140 (Ill. App. Ct. 1986) ("reasonable degree of medical certainty" standard); Fabio v. Bellomo, 504 N.W.2d 758, 763 (Minn. 1993) ("reasonable medical certainty" standard). Shakespeare most elegantly unveiled the nature of semantic formalism: "What's in a name? That which we call a rose by any other name would smell as sweet." WILLIAM SHAKESPEARE, ROMEO AND JULIET, act 2, sc. 2.

<sup>207</sup> See JACK WEINSTEIN, INDIVIDUAL JUSTICE IN MASS TORT LITIGATION: THE EFFECT OF CLASS ACTIONS, CONSOLIDATIONS, AND OTHER MULTIPARTY DEVICES 148 (1995) ("The only real liability issue becomes causation: was this manufacturer's product a substantial cause of this plaintiff's medical problems—however we define them?"); Rosen-

must show that the injury resulted from a defendant's wrongdoing.<sup>208</sup> Where the injury has not yet manifested, the causation analysis goes as follows: The factfinder must determine whether a defendant's negligence would cause a future injury; future injury could be caused by the increased risk or by an independent factor; so if a defendant's conduct increased the risk by at least 51%, a plaintiff would show by a preponderance that the defendant's conduct would legally cause the future injury.<sup>209</sup> This analysis turns a statistical likelihood into a proxy for the factual certainty of injury.<sup>210</sup>

The traditional rule merges injury and causation into a single analysis. Until there is a real injury, whatever it may be as defined by the law, there should not be a cause of action based on that injury, much less a causation analysis. The rule's logic turns tort principles on their heads.<sup>211</sup> Injury and causation are independent inquiries—causation should not prove injury, and vice versa. Stripped of its legal façade, the traditional rule does no more than create a legal fiction of injury where the increased risk was so great that a sense of moral justice cannot ignore the probabilistic truth.

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berg, *supra* note 10, at 855 ("The tort system's capacity to deal effectively with mass exposure cases has been stymied in large part by the burden of proof of causation."); Ayers v. Jackson Township, 525 A.2d 287, 301 (N.J. 1987) ("By far the most difficult problem for plaintiffs to overcome in toxic tort litigation is the burden of proving causation." (citing *Developments in the Law—Toxic Waste Litigation*, 99 HARV. L. REV. 1458, 1617-30 (1986))).

<sup>208</sup> The traditional standard for general causation is a showing that "but for" the defendant's conduct, the plaintiff would not have incurred the injury. PROSSER & KEETON, *supra* note 1, § 41, at 265-66. See also Lapeze, *supra* note 29, at 252-54 (most jurisdictions use "but for" causation test for increased risk cases). The Restatement advocates a "substantial factor" test. RESTATEMENT (SECOND) OF TORTS §§ 431-33 (1965). This standard incorporates the "but for" standard as an "essential precondition," except in situations where there are two or more operative forces. King, *supra* note 24, at 1356. In cases where the defendant was responsible for only one of these forces, and the other could have been sufficient to cause the injury, the defendant's conduct would be a "substantial factor" in bringing about the harm. RESTATEMENT (SECOND) OF TORTS § 432(2). Cf. Summers v. Tice, 199 P.2d 1 (Cal. 1948).

<sup>209</sup> See, e.g., Budden v. Goldstein, 128 A.2d 730, 734 (N.J. Super. Ct. App. Div. 1957) (noting that the traditional rule is "a just balance of the warring interests" of providing remedies upon a showing of "reasonable probability" and doing "reasonably efficient justice if conjecture and speculation are to be used as a measure of damages"), *overruled by* Botta v. Brunner, 138 A.2d 713 (N.J. 1958).

<sup>210</sup> See Ferebee v. Chevron Chem. Co., 736 F.2d 1529, 1536 (D.C. Cir. 1984) (stating that the test for recovery is not scientific certainty but legal sufficiency).

<sup>211</sup> See Robinson, *supra* note 25, at 780-81 ("In the more complex environment of toxic torts, however, the search for deterministic causes—whether cast in the form of the 'substantial factor' or the 'but for' tests of legal causation—is both artificial and misleading.").

*B. Proportionality and Corrective Justice*

Because a defendant is immune from liability so long as the increased risk does not surpass the preponderance threshold, the formulaic distinctions of the traditional rule have been described as "artificial and misleading."<sup>212</sup> The all-or-nothing concept has been severely criticized by many commentators. The thrust of the criticism focuses on the lack of aggregate apportionment between remedy and liability, and so the rule is deemed unfair and arbitrary.<sup>213</sup> By denying any compensation unless a plaintiff proves that a future consequence is more likely than not to occur, courts have created a system that potentially compensates for future consequences that never occur, and conversely denies compensation for consequences that may later ensue. This system is inconsistent with the goal of compensating tort victims fairly for all the consequences of the injuries they have sustained, while avoiding windfall awards so far as possible.<sup>214</sup>

These arguments are straightforward and intuitive. Regardless of whether tort law is based on corrective justice or deterrence theories,<sup>215</sup> meting out compensation commensurate with culpability and injury will in turn deter defendants from socially harmful conduct.<sup>216</sup>

At its core, the proportionality principle is based on a concept of statistical justice, a matching of culpability with expected damages

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<sup>212</sup> *Id.* See also *supra* note 25 (citing scholars who criticize the traditional rule as arbitrary and unfair).

<sup>213</sup> See *Schweitzer v. Consol. Rail Corp.*, 758 F.2d 936, 942 (3d Cir. 1985) ("It is obvious that proof of damages in such cases would be highly speculative, likely resulting in windfalls for those who never take ill and insufficient compensation for those who do.").

<sup>214</sup> *Petriello v. Kalman*, 576 A.2d 474, 482-83 (Conn. 1990) (footnotes and citations omitted). See also *supra* text accompanying notes 178-185 (discussing *Petriello*).

<sup>215</sup> Corrective justice theory posits that the primary goal of tort law is to compensate victims and provide corrective justice where a defendant is proven to have caused the plaintiff's harm. See generally George P. Fletcher, *Fairness and Utility in Tort Theory*, 85 HARV. L. REV. 537 (1972); Kenneth W. Simons, *Corrective Justice and Liability for Risk-Creation: A Comment*, 38 UCLA L. REV. 113 (1990); Ernest J. Weinrib, *Towards a Moral Theory of Negligence Law*, 2 LAW & PHIL. 37 (1982). Deterrence theory posits that the primary goal of tort law is social utility and deterrence of inefficient behavior. See generally LANDES & POSNER, *supra* note 25; Richard Posner, *The Concept of Corrective Justice in Recent Theories of Tort Law*, 10 J. LEG. STUDIES 187 (1981). Some commentators have proposed a "mixed theory" that bridges the two concepts. See Gary T. Schwartz, *Mixed Theories of Tort Law: Affirming Both Deterrence and Corrective Justice*, 75 TEX. L. REV. 1801 (1997).

<sup>216</sup> See PROSSER & KEETON, *supra* note 1, § 4, at 25.

in the aggregate.<sup>217</sup> But critics of the proportionality rule have argued that liability without causation would award damages for injuries that are unlikely to be suffered.<sup>218</sup> Their point is that the plaintiff must single out the specific defendant who caused injury. Each case is an individual search for truth, the argument goes, and what matters is whether the specific plaintiff in *this* case proved the cause of action by a preponderance of the evidence against *this* defendant, as opposed to the overall effect of the law's application on a larger class to which the plaintiff belongs.<sup>219</sup> This argument focuses on the individual transactional nexus between plaintiff and defendant and whether the defendant in fact inflicted the injury on the plaintiff. While I do not disagree with the underlying goal of this proposition,<sup>220</sup> it is at least an incomplete thought and on that basis inaccurate.

To start, the correctness of individual cases does not matter in the eyes of the law. This is not to suggest that the law does not care about correct results. Certainly courts and juries care greatly about the right outcome and strive to achieve it. But it does not shake the foundation of our legal system to say that errors, defined as deviations from the omniscient truth, occur frequently by the very nature of the adversarial system.<sup>221</sup> The judicial process is an institutionalized procedure under which an injured party has the opportunity to obtain the "correct" result and such results are achieved in sufficiently large numbers. The overall accuracy of the system, or aggregate correlation of judgments to the correct results, confirms our confidence in its fairness and ultimately legitimizes the

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<sup>217</sup> "From the standpoint of corrective justice, the proportionality rule is unquestionably more effective than the preponderance rule in achieving the tort system's goal of preserving the value of entitlements." Rosenberg, *supra* note 10, at 881.

<sup>218</sup> See Klein, *supra* note 9, at 1187-94 (noting that corrective justice theorists have been hostile to the proportionality rule because it imposes liability without proof of causation); Wright, *supra* note 29, at 578 ("The disappearance of the causation requirement from the [proportionality rule] and its replacement with mathematical functions . . . is neither scientific progress nor a cause for celebration.").

<sup>219</sup> See Ernest J. Weinrib, *Causation and Wrongdoing*, 63 CHI.-KENT L. REV. 407, 429 (1987) ("[C]ausation particularizes by singling out this plaintiff from the class of persons whom the defendant has endangered.").

<sup>220</sup> This article agrees that a transactional nexus is required between plaintiff and defendant. See *infra* Section V.E. This necessarily means that the injury must be causally connected to the defendant's culpability and not some market share theory of liability. But the question is: What is the injury?

<sup>221</sup> "It is no longer controversial, I think, to argue that there is no moral or practical reason to insist that victims be denied recovery or that some wrongdoers escape liability simply because we are unable to match wrongdoers with their victims." Saul Levmore, *Probabilistic Recoveries, Restitution, and Recurring Wrongs*, 19 J. LEGAL STUD. 691, 698 (1990).

system. If this was not the common perception, our justice system could not exist for no rational society would perpetuate a process that consistently achieves the wrong results.

In our adversarial system, one way to consider a lawsuit is a zero-sum game in which one party's gain is another's loss.<sup>222</sup> We can distinguish two kinds of games: games of pure chance, where a player has no input into the overall odds of winning (e.g., dice or roulette), and games of skill, where acumen or knowledge can influence the result even though the game still has significant elements of chance (e.g., poker or backgammon).<sup>223</sup> The former can be classified as a pure gamble, a speculation in the true sense of that word,<sup>224</sup> whereas the latter combines random risk with a rational, risk-based decision-making process.<sup>225</sup> Transactions in the legal and financial markets are typically games of skill because many factors within the control of the parties can affect the end result.

Higher ideals aside, a lawsuit is also a financial investment by the plaintiff and her attorney.<sup>226</sup> The plaintiff provides the business

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<sup>222</sup> See R. Duncan Luce & Howard Raiffa, *Games and Decisions: Introduction and Critical Survey* 56-87 (1958) (discussing two party zero-sum games).

<sup>223</sup> See BERNSTEIN, *supra* note 41, at 14 ("Games of chance must be distinguished from games in which skill makes a difference. . . . With one group of games the outcome is determined by fate; with the other group, choice comes into play.").

<sup>224</sup> See *supra* note 201.

<sup>225</sup> Cf. Roy Kreitner, *Essay, Speculations of Contract, or How Contract Law Stopped Worrying and Learned to Love Risk*, 100 COLUM. L. REV. 1096 (2000) (discussing how contract law has accepted the notion of risk). Contracts in the financial markets, such as derivatives, come close to being pure gambles on uncertainty. On the one hand, each party uses information, knowledge and skill to seek an advantage or arbitrage. On the other hand, predicting the movement of any price has been a perilous venture since the dawn of commercial trade. Consider for example derivatives, which are pure bets on the price movement of the underlying asset. When massive amounts are invested in them through leverage, wrong bets can have spectacular consequences, as was the case with Long-Term Capital Management ("LTCM"). See generally ROGER LOWENSTEIN, *WHEN GENIUS FAILED: THE RISE AND FALL OF LONG-TERM CAPITAL MANAGEMENT* (2000). LTCM was an arbitrage fund with \$100 billion in assets and \$4.7 billion in equity (meaning that most of the firm's assets were borrowed), and in 1998 it had entered into thousands of derivatives contracts with a combined exposure of over \$1 trillion. *Id.* at xix-xx. In the wake of the August 17, 1998, debt moratorium by the Russian government, LTCM suffered a precipitous fall that threatened not only the vast sums invested in the fund but also the systemic stability of the global derivatives market. *Id.* at 144. Ironically, two of LTCM's partners were Myron Scholes and Robert Merton, both Nobel Prize winners for their pioneering work on derivative pricing techniques. Despite these occasionally spectacular hiccups, derivatives have enormous value in risk management and can hedge risk if used properly. See *supra* note 107.

<sup>226</sup> This is the approach taken by most plaintiffs and their attorneys. Contingent fee arrangements prevalent in personal injury cases are essentially equity partnerships where the plaintiff provides the business opportunity and the attorney provides the intellectual

opportunity, and the attorney provides not only the intellectual capital and labor but often the financial capital in the form of contingent attorney's fees and costs. Most plaintiff lawyers are entrepreneurs, and they conduct their business with an eye toward economic self-interest.<sup>227</sup> The decision to undertake a case is like any other sound investment decision, including an assessment of the business partner (plaintiff), the competitive environment (opposing attorney and party), the business environment (legal forum and judicial climate), and a risk-reward analysis including the opportunity cost of capital (other cases foregone). The value of this financial investment depends on the underlying risk. Components of the litigation risk can be unpacked as Markowitz did for investment risk.<sup>228</sup> Borrowing from the Efficient Portfolio Theory, we can isolate two kinds of litigation risk: general and unique risk.

General risk encompasses the systemic process risk associated with the legal forum, which can be seen as a market. This market risk constitutes the uncertainty associated with the decisions of the jury and the judge, who are influenced by their life experiences, opinions, predispositions, and the prevailing community standards. General risk is unrelated to the case, and is systemic to all lawsuits brought before deliberative bodies. It not only includes the risk of unpredictable human interactions, but also unpredictable discretionary decisions where there are two or more decision paths, neither of which could be classified as wrong or irrational in the sense of reversible error. Under this view, reversible error can be understood to occur when a deliberative body arbitrarily increases the general risk of a litigant beyond the range of rational multivariate decision-making. A lawsuit with only general risk is akin to a game of pure chance. The matter is left purely to the deliberative bodies without input or influence, and it is no surprise that many practicing trial lawyers consider the unpredictability and randomness of a trial as akin to a pure gamble.<sup>229</sup>

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and financial capital. See generally Rhee, *supra* note 199; Marc A. Franklin et al., *Accidents, Money, and the Law: A Study of the Economics of Personal Injury Litigation*, 61 COLUM. L. REV. 1 (1961) (discussing economics of attorney-plaintiff relationship).

<sup>227</sup> Charles A. Wolfram, *The Second Set of Players: Lawyers, Fee Shifting, and the Limits of Professional Discipline*, 47 LAW & CONTEMP. PROBS. 293, 295-96 (1984). See also Rosenberg, *supra* note 10, at 890 ("The primary goal of plaintiff attorneys is to maximize not the expected judgment, but rather their own expected return—their fees.").

<sup>228</sup> Markowitz, *supra* note 45; see also *supra* text accompanying notes 47-54.

<sup>229</sup> Scott Shane, *Md. to Join Tobacco Settlement*, BALT. SUN, Nov. 21, 1998, at A1 ("[Maryland] did not want to gamble on taking the case to trial" in approving \$206 billion settlement which would net Maryland \$4.2 billion (quoting Maryland Attorney General J. Joseph Curran, Jr.)); John Steinman, *Couple to be Sentenced in Foster Child's Death*, L.A.



Unique risk is the risk associated with the specific case. This risk is itself comprised of two general categories: the totality of the factual and evidentiary circumstances and the substantive and procedural laws specifically applicable to the case. Unique risk encompasses factors such as the strength of the facts, the client's likeability and the sympathy she will or will not elicit from the factfinder, the quantity and quality of witnesses, the skill of the lawyers and the financial resources of the parties. The substantive law is also a key determinant. The law can skew the risk for one party or another, and often the risk is allocated based on various policy and efficiency grounds.<sup>230</sup> All of these factors combine to create the unique risk profile for any given case. Because some of the randomness or unpredictability of the lawsuit is eliminated by these factors, unique risk converts a lawsuit from a game of chance to a game of skill.

In only the minority of cases is the total risk, defined as the combination of general and unique risks, said to be evenly distributed. All things considered, one party generally has the edge. This is the nature of competition. For the purpose of this discussion, however, we can imagine a jurisdiction in which judges are perfectly neutral administrators of the law and juries rationally apply the law to the facts.<sup>231</sup> Accordingly, general risk is mitigated to its natural state, the risk inherent in the randomness of rational multivariate decision-making.<sup>232</sup> In this perfectly efficient legal system, the simplest

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TIMES, Oct. 9, 1997, at B5 ("[T]aking the case to trial is a gamble . . ." (quoting attorney H. Russell Halpern)).

<sup>230</sup> The clearest example of such skewing is criminal law, which greatly skews the risk in favor of the defendant. This does not mean that errors are less tolerated in criminal cases. In fact, the opposite is true—more errors are tolerated in favor of the defendant. Accordingly, the law imposes standards by which the defendant's unique litigation risk is greatly mitigated. See, e.g., *Miles v. United States*, 103 U.S. 304, 312 (1880) ("The evidence upon which a jury is justified in returning a verdict of guilty must be sufficient to produce a conviction of guilt, to the exclusion of all reasonable doubt."); *Strickland v. Washington*, 466 U.S. 668, 684-687, (1984) (providing constitutional guarantee of reasonably effective counsel); *Brady v. Maryland*, 373 U.S. 83, 86-88, (1963) (holding that the Due Process Clause of the Fourteenth Amendment requires the state to disclose all exculpatory evidence against the defendant).

<sup>231</sup> It has been said that the reasonably prudent person is "a fictitious person, who never has existed on land or sea." PROSSER & KEETON, *supra* note 1, § 32, at 174-75. Likewise, this hypothetical jurisdiction of perfectly impartial and objective deliberative bodies has probably never existed.

<sup>232</sup> Parenthetically, it is this remaining risk that makes the law an entirely human affair, for we cannot conceive of a day in which logical decision trees programmed into a computer would mete out justice in place of judges or juries. Cf. Cass R. Sunstein, *Of Artificial Intelligence and Legal Reasoning* (University of Chicago Law School Roundtable, Public Law Working Paper No. 18, Nov. 2001), available at <http://papers.ssrn.com/paper.taf?>

of tort cases is brought: a suit seeking compensation for property damage to a car resulting from a two car accident on a lonely stretch of country road. Plaintiff says the traffic light was green, defendant says it was red, and there are no other witnesses. Plaintiff and defendant are equally situated in terms of reputation, personal appeal, financial resources, attorney skill and other circumstances that could affect the case. In other words, unique risk is equally distributed to plaintiff and defendant. What is the truth?

Absent an omniscient factfinder, the dispositive “fact” (the color of the traffic light) is like Schrödinger’s cat.<sup>233</sup> It is neither true nor false; it exists as a probability function.<sup>234</sup> As a result, in most cases we will not find absolute truth, only legal certainty.<sup>235</sup> This particular case could then be resolved based on a twitch of the eye, a shift-

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abstract\_id=289789 (arguing that artificial intelligence cannot now engage in sophisticated legal reasoning but leaving open the possibility that such reasoning can be achieved in the future).

<sup>233</sup> Erwin Schrödinger was an early twentieth century atomic physicist who researched quantum mechanics. Unlike classical physics, quantum mechanics postulated that we cannot measure the exact position of subatomic particles, and that they exist only as probability functions along different space and time configurations. To demonstrate this, Schrödinger proposed a thought experiment. Erwin Schrödinger, *The Present Situation in Quantum Mechanics*, reprinted in *Quantum Theory and Measurement* 152 (John Archibald Wheeler & Wojciech Hubert Zurek eds., John D. Trimmer trans., 1983). A cat sits in a sealed box facing a gun. The gun is connected to a Geiger counter, which is connected to a block of radioactive uranium. If a uranium atom’s nucleus decays, the Geiger counter will activate and trigger the gun. Schrödinger asked whether the cat was alive or dead before opening the box. Most of us would say that the cat exists in an alternative, mutually exclusive dead or alive state. Under quantum theory, however, the cat is neither dead nor alive, but exists as a probability function. Various scientists and philosophers have pondered the meaning of this thought experiment within and outside of the discipline of quantum physics. See generally MICHIO KAKU, *HYPERSPACE* 260-61 (1995) (presenting a general discussion of Schrödinger and his thought experiment); BRIAN GREENE, *THE FABRIC OF THE COSMOS: SPACE, TIME, AND THE TEXTURE OF REALITY* 211 (2004); HELGE KRAGH, *QUANTUM GENERATIONS: A HISTORY OF PHYSICS IN THE TWENTIETH CENTURY* 217 (1999).

<sup>234</sup> Much of legal fact finding is based on incomplete information and uncertainty. See Vern R. Walker, *Theories of Uncertainty: Explaining the Possible Sources of Error in Inferences*, 22 *CARDOZO L. REV.* 1523 (2001) (proposing a “theory of uncertainty” to deal with the uncertainties in fact finding).

<sup>235</sup> There are many cases where truth appears to be absolute. The Rodney King videotape is a good example. We saw what happened on the video, but then the trial turned on the interpretation of the recorded event. The “truth” under law became entangled in a credibility dispute, an element of unique litigation risk. The jury verdict was as unpredictable as the resulting riots in Los Angeles. See Elizabeth F. Loftus & Laura A. Rosenwald, *The Rodney King Videotape: Why the Case Was Not Black and White*, 66 *S. CAL. L. REV.* 1637, 1644 (1993) (arguing that videotaped events need “context” and are subject to widely varying interpretations); David Sternbach, Note, *Hanging Pictures: Photographic Theory and the Framing of Images of Execution*, 70 *N.Y.U. L. REV.* 1100, 1141 (1995) (“Photographic images offer appearances, but they do not offer meanings.”).

ing in the seat, a misunderstanding of a phrase or a carefully timed smile. Even in this most simple traffic accident example, there is a significant chance that the judicial system will produce the wrong answer. The plaintiff and defendant would have an approximately even chance of winning, but with little correlation between the omniscient truth and individual judgment. Culpable plaintiffs could be awarded a remedy, while victimized plaintiffs could be denied. Where general risk is mitigated to its natural state and unique risk is equally distributed, the case takes on the characteristic of a game of chance. Given one hundred such cases, the law could err in as many as half the cases. The maxim "justice is blind" means not only that individuals will be treated fairly, but also that the law is blind to individualized error rates. Fairness (or justice) does not equate to individualized correctness. In short, the law guarantees a fair process but not necessarily correct results.<sup>236</sup>

This shows the fallacy of the argument put forth by the corrective justice theorists. While causation in most ordinary torts is obvious and so seldom an issue, causation as the concept has been used in increased risk cases is problematic. When it is applied as a predictive device, the accuracy of that prediction becomes an issue. Each close case could err as much as 50% in a perfectly efficient legal system—a terrible result if viewed in isolation. Yet we are not troubled by a high error rate in the truth-seeking process in close cases. On a practical level, we are resigned to a certain truth-seeking process for we cannot calculate the risks in the first place unless a process is employed to evaluate that risk. Paradoxically, that process would constitute a component of the risk it seeks to assess.<sup>237</sup> Because the legal process is risky, we expect some unpredictability and are only troubled if the result was achieved through

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<sup>236</sup> See John E. Calfee & Richard Craswell, *Some Effects of Uncertainty on Compliance with Legal Standards*, 70 VA. L. REV. 965, 968 (1984) ("Indeed, there is always some chance of error in the legal system, and at the time defendants must choose their behavior it will usually be hard to predict the kinds of evidence that will be available when they are brought to trial, the persuasiveness of the witnesses and advocates who will participate in that trial, or the temperament of the judge or jury at the time of their decision.").

<sup>237</sup> There is another analogy to a principle in quantum physics. The Heisenberg Uncertainty Principle states the paradox that the position and speed of a subatomic particle cannot be ascertained in its natural state because the act of observing it affects the qualities observed. See WERNER HEISENBERG, *PHYSICS AND BEYOND: ENCOUNTERS AND CONVERSATIONS* 76-81 (Ruth H. Anshen ed., Arnold J. Pomerans trans., 1971); KRAUGH, *supra* note 233, at 207-09; WILLIAM H. CROPPER, *GREAT PHYSICISTS: THE LIFE AND TIMES OF LEADING PHYSICISTS FROM GALILEO TO HAWKING* 284-85 (2001). Likewise, we can never assess the litigation risks without actually undertaking the lawsuit, but the legal process itself constitutes a part of that risk.

extraordinary process error. In the extreme case where general and unique risks are perfectly distributed,<sup>238</sup> the game becomes one of pure chance—a speculative gamble. Nevertheless, the legal process would not be troubled by this implied randomness because the litigation risk is equally assumed by the parties.<sup>239</sup>

We continue the car accident hypothetical and assume an expert study shows that the terrain on the defendant's side of the road could potentially induce an inattentive driver to become disoriented. Based on this data, an expert concludes that 55% of all past accidents were due to defendants' inattention and opines that the defendant in this case was probably negligent.<sup>240</sup> What result? In one hundred such cases, we expect that a factfinder would find for the plaintiff in fifty-five cases based on the combined litigation risk. Even when the facts favor one party, as they do here, the other party would win a substantial minority of cases based on the unpredictability and randomness associated with rational multivariate decisionmaking. Certainly unexpected results at trial, achieved without reversible error, are not surprising. But in an efficient system the aggregate results should statistically reflect the underlying risks. Under these facts, we are still not guaranteed correctness.<sup>241</sup>

Now suppose a review of one hundred such accidents in the jurisdiction shows that defendants actually won eighty-nine cases in which the expected result is only forty-five wins. If general risk has been mitigated to multivariate rationality, and if unique risk has

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<sup>238</sup> Many cases go to trial precisely because the risks are so evenly distributed, and other cases settle because the parties have rationally opted to split the difference in a settlement rather than risk trial.

<sup>239</sup> The litigants are keenly aware of the prospect for speculation, which explains why most lawsuits never make it to trial. Trials are expensive and the risks are great, sometimes unknown even to experienced trial attorneys, thus explaining why most cases never reach trial. In 2002, out of 258,876 cases filed in the United States District Courts, only 4,569 (or 1.8 percent) went to trial. Marc Galanter, *The Vanishing Trial: An Examination of Trials and Related Matters in Federal and State Court*, Symposium on The Vanishing Trial Sponsored by the Litigation Section of the American Bar Association at 2 (December 12-14, 2003) (to appear in 1 J. Empirical L. Studies \_\_\_\_ (Nov. 2004)). In 1962, the comparative figures were 50,320 and 5,802 (11.5 percent). *Id.* The decrease in number and percentage of trials shows a "striking philosophical, ideologically driven view that is hostile to trials." Adam Liptak, *U.S. Suits Multiply, But Fewer Ever Get To Trial, Study Says*, N.Y. TIMES, Dec. 14, 2003, at A1 (quoting Judge Patrick Higginbotham of the United States Court of Appeals for the Fifth Circuit). Accident cases have produced similar data. See Franklin et al., *supra* note 226, at 10 (2,500 cases reached verdicts in New York City compared to 193,000 claims; i.e., less than 2 percent).

<sup>240</sup> We assume that such evidence passes scrutiny under *Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579 (1993).

<sup>241</sup> Cf. D.H. Kaye, *Apples and Oranges: Confidence Coefficients and the Burden of Persuasion*, 73 CORNELL L. REV. 54 (1987).

been determined to be 55/45 in favor of plaintiffs, the results are anomalous. Perhaps this odd data would not alarm some given that we are dealing with money and not liberties or lives. It could be ignored as a statistical fluke. However, the data would pique interest, at least, for it hints at a systemic error rate that cannot be accounted for by general or unique risk. While the results of each case can be explained by the randomness or unpredictability of the justice system, collectively the errors suggest a systemic problem.

The point of this discussion is to underscore the obvious facts that even past events are uncertain in the present, and future consequences can never be predicted with certainty. Uncertainty is a part of the human condition. Most knowledge and legal evidence are probabilistic in nature.<sup>242</sup> Probability can be assessed and discussed in qualitative terms such as credibility and weight of the evidence, or in terms of statistics. The concept is the same. Under this view, the standards of proof simply set forth error tolerance rates relating to the litigation risk.<sup>243</sup> We do not complain that errors in the omniscient sense occur or even that the individual error rates are high in some cases. But systemic errors concern us for they are the byproduct of an inefficient process that arbitrarily increases general or unique risks, or both. This increased risk unfairly influences the individual outcome, and thus the result (whether correct or incorrect in the omniscient sense) is said to be achieved through extraordinary process error.

These truths must be incorporated into the legal rubric that does justice to a broader understanding of risk and value. Society expects not correct individualized results—the primary concern of corrective justice theorists in this field—but a fair process that achieves overall corrective justice for plaintiffs and deterrence for defendants. Implicit in this social bargain are two things: (1) the process will not impose an extraordinary increase in general or unique risk in each individual case, (2) resulting in fairness achieved through probabilistic results that reflect a certain statistical justice for the collective whole. If these twin goals are

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<sup>242</sup> Almost all evidence is probabilistic. *DePass v. United States*, 721 F.2d 203, 230 (7th Cir. 1983) (Posner, J., dissenting). See also *Petriello v. Kalman*, 576 A.2d 474, 484 (Conn. 1990) (medical statistics can establish with a degree of certainty the likelihood of a future injury and the risks); King, *supra* note 24, at 1385 (“[A]ll factual evidence is ultimately statistical and probabilistic in the epistemological sense.”).

<sup>243</sup> There are three major standards of proof: preponderance of the evidence, clear and convincing, and beyond a reasonable doubt. See *Colorado v. Connelly*, 479 U.S. 157 (1986) (discussing the three standards). These standards set out the various error tolerance levels, which are set based on the underlying interests at stake.

achieved, it does not matter that the legal system has produced an individual error, for the law is a human endeavor.<sup>244</sup> Thus, our justice system has a distinct utilitarian quality based on a notion of statistical justice.<sup>245</sup>

### C. *Statistical Justice and "Loading the Dice"*

Under this notion, it violates the implicit bargain to impose arbitrariness into the process. This means that the legal process should not "load the dice." Cases should not be determined by the race of the parties, the illicit prejudices of deliberative bodies, irrational decision-making, perjury of witnesses, or misdeeds of attorneys. Obviously, these things inject extraordinary risk into the legal process. The resulting decision falls outside the bounds of multivariate rationality and unfairly alters the natural state of the general or unique risk profile for that particular case, creating the possibility of reversible error on appeal.

Thus far, the discussion has centered on process-oriented risk and error. The substantive rules of law can also affect unique risk by "loading the dice" in a party's favor. In the above hypothetical, assume that the anomalous discrepancy between expected and actual results (forty-five versus eighty-nine cases) is due to the following rule of law: all traffic accident cases where the verdict is rendered on Monday through Thursday will result in a directed verdict for the defendant; otherwise the judgment will be consistent with the jury's verdict. This peculiarity in the substantive law

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<sup>244</sup> I limit this discussion to civil cases. Criminal cases pose a far more difficult weighing of acceptable errors. For some, the death penalty is troubling not because death is categorically an abhorrent punishment, but because we must recognize that errors in the legal process occur as a necessary product of human deliberation and so there is the possibility, however infrequent or remote, of executing an innocent person. See *Callins v. Collins*, 114 S.Ct. 1127, 1129-30 (1994) (Blackmun, J., dissenting from denial of certiorari) ("On their face, these goals of individual fairness, reasonable consistency, and absence of error appear to be attainable: Courts are in the very business of erecting procedural devices from which fair, equitable, and reliable outcomes are presumed to flow. Yet, in the death penalty area, this Court, in my view, has engaged in a futile effort to balance these constitutional demands . . . . From this day forward, I no longer shall tinker with the machinery of death.").

<sup>245</sup> Nevertheless, courts have generally adhered to a mechanistic and deterministic conception of causation, which "reflects an intellectual uneasiness about probabilistic concepts themselves." Robinson, *supra* note 25, at 780. Some commentators, however, have voiced concerns that reliance on statistics may diminish justice. See, e.g., Daniel Shavero, *Statistical-Probability Evidence and the Appearance of Justice*, 103 HARV. L. REV. 530 (1989); Lawrence Tribe, *Trial by Mathematics: Precision and Ritual in the Legal Process*, 84 HARV. L. REV. 1329 (1971). Others have suggested that statistics can assist in the truth seeking process of the law. See, e.g., David Kaye, *The Laws of Probability and the Law of the Land*, 47 U. CHI. L. REV. 34 (1979).

perfectly explains the 89% favorable verdict rate for defendants.<sup>246</sup> Of course, we cannot countenance these errors.<sup>247</sup>

The law scrutinizes the overall results achieved and seeks substantive rules that will make the legal system more efficient in the overall sense. This is the very essence of the common law—a process of continued reconstitution of the law looking to past experience to solve present problems and anticipating future issues to do substantial justice on the grander scale.<sup>248</sup> The process of evaluating the overall results also takes place in the legislative and executive branches of government as the statutory laws are continuously reviewed.<sup>249</sup> A rule of law in the field of torts should induce results consistent with an overall statistical justice of error minimization.

This underlying concept is not as apparent in the context of an ordinary accident because physical injury and causation are confirmed routinely,<sup>250</sup> and the substantive law does not directly affect the process that hopes to achieve the “correct” result. Ordinary accidents produce ordinary results on the whole, and these results do not test the legal system. The unique risks inherent in the rule of law are evenly distributed, favoring neither defendant nor plaintiff. Each case is said to be determined on its “merits” based on

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<sup>246</sup> Statistically, if we assume that the one hundred cases are spread evenly throughout the week, the eighty brought Monday through Thursday will automatically be decided for the defendant. On Fridays, eleven cases will be decided for the plaintiff and nine for the defendant (a 55/45 split as predicted by the expert report). This results in an 89% success rate for the defendant.

<sup>247</sup> This Monday-Friday rule is a fanciful example. But irrationality in substantive rules of law presents itself throughout legal history. Few can argue that the decisions in *Plessy v. Ferguson*, 163 U.S. 537 (1896), or *Korematsu v. United States*, 323 U.S. 214 (1944), were rational, though they were argued as such at the time. As time changes, so does the law, as society may come to consider irrational what was once considered reasonable. See *Lawrence v. Texas*, 539 U.S. 558, 571 (2003) (noting that “historical premises” were misconstrued in *Bowers v. Hardwick*, 478 U.S. 186 (1986), and “our laws and traditions in the past half century are of most relevance here”). Tort law too has seen irrationality at work. For instance, contributory negligence disproportionately allocates the risks of an accident to the plaintiff, and a large majority of jurisdictions have rejected the doctrine for the more equitable doctrine of comparative negligence. See PROSSER & KEETON, *supra* note 1, § 65, at 453, § 67, at 468-69.

<sup>248</sup> See OLIVER WENDELL HOLMES, JR., *THE COMMON LAW* 1 (1881) (“The life of the law has not been logic: it has been experience.”).

<sup>249</sup> This is apparent in recent reviews of death penalty cases. See Emanuel Margolis, *New Life for Connecticut's Death Penalty: Revisited*, 74 CONN. B.J. 216, 233-34 (June 2000) (discussing the indefinite moratorium on death penalties in Illinois announced on January 31, 2000); JAMES LIEBMAN ET AL., *A BROKEN SYSTEM: ERROR RATES IN CAPITAL CASES, 1973-1995*, at 4-5, 30 (2000) (Columbia Law School study of 4,578 death penalty sentences from 1973 to 1995 showing an overturning rate of 41% due to “serious errors” and an “overall error rate” of 68%).

<sup>250</sup> See *supra* note 5.

proof that this defendant injured this plaintiff, which is the primary concern of corrective justice. Each case too has the same susceptibility to error, but across a large pool of cases these errors would average out to produce a fair correlation of overall liability to remedy. Under these circumstances, the preponderance of the evidence rule has been shown to be more accurate than the proportionality rule.<sup>251</sup>

Levmore explains the efficiency of the preponderance rule in most ordinary accidents this way. Suppose there is a 75% chance that A injured the victim and a 25% chance that B caused the injury, which is valued at \$100.<sup>252</sup> Under the preponderance rule, A is assessed liability of \$100 while B escapes liability. In three out of four situations, this achieves the correct result and the error is nil. In one out of four situations, the law erred by assessing \$100 liability to A and failing to assess the same against B, a total error of \$200. The expected average error then is \$50. Under the proportionality rule, A and B are assessed \$75 and \$25, respectively. In three of four situations, A is the culpable one but underpays by \$25 and B is erroneously assessed \$25, a total error in the three cases of \$150. In one out of four situations, A is wrongly assessed \$75 while B underpays by \$75, a total error of \$150. The expected average error then is \$75. In most ordinary accidents, therefore, the preponderance of the evidence rule minimizes errors.<sup>253</sup> There are no undue influences on the general or unique risk because in the larger scheme liability matches culpability more accurately, and by agreeing to litigate the parties assume the risk equally in the legal process.

In increased risk cases, however, there is a conflict between the twin policies of achieving correctness in the individual case and efficiency on the whole. The traditional rule has been defended on the basis of achieving the correct result in individual cases through the requisite showing of injury and causation. But, as discussed, such a goal is a chimera in increased risk cases.<sup>254</sup> The very notion that we can achieve individualized “correct” results in cases requiring predictions into the future is dubious. In seeking correctness in

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<sup>251</sup> See Levmore, *supra* note 221, at 694 (noting that the preponderance rule applied to ordinary accidents “may be the dominant rule in the legal system precisely because it minimizes error—at least for a single case”).

<sup>252</sup> *Id.* at 693.

<sup>253</sup> *Id.*; see also Dumas v. Cooney, 1 Cal. Rptr. 2d 584, 593 (Ct. App. 1991) (discussing the error rates of a preponderance and proportionality schemes).

<sup>254</sup> See *supra* note 26 and pages 140-44, 149-52.



the individual case, the substantive law produces gross disparities in the collective whole.<sup>255</sup>

Again simple math exercises demonstrate this point. Assume there are four exposed plaintiffs and damage for the future injury is \$100. If there is a showing of a 50% likelihood of future injury, a defendant will have no liability under the traditional rule, though the expected value of damages on a probabilistic basis is \$200. If there is a showing of 51%, the defendant's liability is \$400, though the expected value is \$204. When these cases are seen in context, the correlation between liability and expected value of damages is imperfect.<sup>256</sup>

We take the hypothetical a step further. Assume each of the four persons is exposed to a 25% risk and they file lawsuits. The timing of the lawsuit varies: three file suit immediately and one when the injury manifests, if at all.<sup>257</sup> Under the traditional rule, the results are: in three out of four scenarios, the defendant's total liability will be nil, and in one out of four the total liability will be \$100. The expected liability is \$25, though the expected damage is \$100. Under a proportionality rule, the results are: in three out of four scenarios, the defendant's total liability will be \$75, and in one out of four scenarios the defendant's total liability will be \$175. The expected liability is \$100, which is the same as the expected damage.

These simple examples show that the proportionality rule minimizes errors across a larger class of cases.<sup>258</sup> Because increased risk cases rarely meet the preponderance threshold, plaintiffs are consistently under-compensated and defendants consistently escape liability—an effect Levmore calls a “recurring miss.”<sup>259</sup> This error rate built into the substantive law means that the tradi-

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<sup>255</sup> See Levmore, *supra* note 221, at 721 (describing certain situations where defendants consistently escape liability).

<sup>256</sup> Under the proportionality rule, the expected payout is perfectly correlated to the expected damages. See *id.* at 697 (“The expected error of the probability rule is thus very close to zero.”).

<sup>257</sup> We assume no statute of limitations problem. See *supra* text accompanying notes 150-151. As discussed later, this article argues that statute of limitations should be abolished in these cases on the basis of mutual informational efficiency. See *infra* Section VII.B.

<sup>258</sup> “The important point is that it is hard to see why errors should be measured in a case-by-case, rather than an aggregate, manner when a probabilistic rule accomplishes virtually all that an omniscient factfinder would do.” Levmore, *supra* note 221, at 698.

<sup>259</sup> By using as an example the celebrated case of *Haft v. Lone Palm Hotel*, 478 P.2d 465 (Cal. 1970), Levmore considers the problem of “recurring misses” in the preponderance of the evidence rule and shows how it may be met with a “probabilistic solution.” Levmore, *supra* note 221, at 705-10.

tional rule arbitrarily increases a plaintiff's unique risk in any given case. But critics of the proportionality rule may note that there is a situation where the defendant pays liability in excess of expected damages (the 25% chance that liability will be \$175). This could be viewed as producing a flawed result because some plaintiffs are said to be overcompensated while the defendant is over-deterred.

There are two points to note here. First, the overcompensation argument assumes that liability for physical injury is the baseline from which appropriate compensation is determined. But freedom from increased risk and freedom from physical injury are two independent interests.<sup>260</sup> They share some common elements and derive from the same fact pattern, but they are different interests just the way a common set of facts can create liability for two different causes of action for different damages. Accordingly, the baseline for comparison should be the damages for increased risk and for personal injuries. In a right combination of events, a defendant may be liable for injuries to both interests (but not to the same plaintiff),<sup>261</sup> in which case the \$175 payout is not overcompensation at all but the full theoretical liability.

Second, assuming *arguendo* that the \$175 payout overcompensates plaintiffs, the result is based on a hypothesized 100% filing rate, which is an unrealistic assumption. For the purpose of calculation, we assume two things: (1) a 75% filing rate, meaning one person will not sue for whatever reason, and (2) of the remaining three plaintiffs, we apply the same timing assumption, i.e., two persons will file suit immediately and one person will file suit upon a physical manifestation. These assumptions provide a more realistic sense of the diversity of choices involved in this problem. Under these assumptions, there is a 91.7% chance that liability will be apportioned at \$50, and an 8.3% chance that liability will be \$150.<sup>262</sup> On a weighted average basis, the resulting expected liabil-

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<sup>260</sup> See *infra* text accompanying notes 279-322.

<sup>261</sup> As explained later in this article, a defendant can be held responsible for both the physical injury and any increased risk injury. A defendant can be responsible for an increased risk of injury, but the plaintiff is barred from later suing for a physical injury upon manifestation. See *infra* note 322 and accompanying text.

<sup>262</sup> In deriving these figures, I assume the presence of four plaintiffs, A, B, C, and D, in the following calculations: A has a 25% chance of death and there is a 25% chance that A will be the non-filing plaintiff, or a 75% chance that the filing plaintiffs will be B, C, and D. Of these three plaintiffs, based on the timing assumption, two will file suit immediately and one will wait for a disease that will never manifest. Thus, in 75% of the cases, the liability to these three plaintiffs as a group is \$50. This leaves 25% of the cases where A is among those who will choose to file suit. Among these 25% of the cases, there is a 33% chance that A will be the plaintiff who waits until manifestation, in which case the liability is \$150

ity will be exactly \$58 compared to the expected damages of \$100. This shows that the filing rate and timing of lawsuit (assuming there is no statute of limitations problem) significantly affect the ultimate liability payout matrix. While we may assume for discussion purposes an efficiency between injury and filing rate, in truth there is an inefficiency which benefits defendants. Reasons why meritorious cases go unfiled are plentiful: lack of knowledge of the wrong, inability to find an attorney, discounting of relatively minor increase in risk, indifference or denial, lack of diligence and apprehension of prosecuting a lawsuit. Moreover, if the legal regime increases litigation optionality by eliminating the statute of limitations, timing plays a significant factor in increasing or decreasing total expected liability.<sup>263</sup> Only in the clean world of theory is there perfect deterrence; in truth defendants are always under-deterred because of the choices made by victims, informational inefficiencies in the process, or a combination thereof. Thus, the overcompensation problem is not as significant even if increased risk and physical injuries are jointly compensated.

The theoretical basis for the traditional rule and the concerns of the corrective justice theorists are full of contradictions. Courts have shunned a statistical approach in creating substantive rules of law applicable to the collective whole while at the same time dogmatically embracing it in the evidentiary process of determining liability in each individual case. The traditional rule violates the fundamental law of probabilities—the rule of large numbers—which states that calculations of chance require sufficient sample quantities so that individual variance is mitigated. It is of little value to apply a probability rule to a sample of one and expect to achieve the “correct” result in that case because the law of statistics and legal experience say that each individual case can vary greatly from the expected mean, i.e., the omniscient truth.<sup>264</sup> Errors produced by the variance of general or unique risk, without more, is not troubling. But when they are the product of extraordinary litigation risk, there is a systemic problem with the process.

A proportionality rule greatly improves the overall accuracy of matching the expected value of the total damages to liability. The

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(an all-in probability of 8.3% of the total cases); and a 67% chance that A and another plaintiff will file suit immediately and the remaining plaintiff will wait for a disease that will never manifest, in which case the liability is \$50 (an all-in probability of 16.7% of the cases). In sum, 91.7% of the cases will yield \$50 in liability and 8.3 percent will yield \$150.

<sup>263</sup> See *infra* Part VII.B (discussing statutes of limitations).

<sup>264</sup> In statistics, variance measures the degree to which each data point deviates from a regression.

all-or-nothing rule contradicts this matching principle. The substantive rule of law is not neutral as in most ordinary accidents where the preponderance of the evidence rule generally works well. The law should seek to produce efficient results. Expected damages should correlate to expected liability within the broader context as in most ordinary accidents. In increased risk cases, however, the substantive law “loads the dice” in favor of the defendant, thereby arbitrarily increasing the plaintiff’s unique risk in each individual case.<sup>265</sup>

#### D. Other Policy Considerations

There are two other policy considerations that require discussion: the “slippery slope” and “floodgate” arguments. These arguments are related. At any given time, a person is exposed to an infinite variety of risks, natural and artificial, and the question becomes whether even a *de minimis* increase in risk is actionable. If not, where is the threshold? We can immediately dismiss the notion that any fleeting risk creates a cause of action. Instantaneous risk is distinguished from latent risk. Most accidents result from mishaps of instant transactions between parties: a man drives drunk, a woman negligently handles a fork crane, a utility forgets to turn off the gas line, etc.<sup>266</sup> These acts or omissions create potentially grave but temporally minute risks. Their repercussions immediately follow. If there is no adverse consequence, there is no liability because no harm resulted. Strictly speaking, the defendant’s conduct did increase the risk of physical injury. Nevertheless, this harm is not actionable because cost internalization at this level is the price for living in an imperfect world.

This does not mean that an instantaneous increase in risk is not redressable at all. Where the risk created is palpable but fleeting, the law transitions from a private recovery scheme to a public deterrence system.<sup>267</sup> Causing such risks is actionable via public enforcement of administrative and criminal regulations. Drunk driving is a good example. Although the act may result in no accidents, it is punishable by law because it creates the risk of harm. For each individual concerned, the risk is fleeting at most, but the

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<sup>265</sup> Kaye, *supra* note 245, at 36 (suggesting that “the only real question is . . . whether the [probability] technique would reduce the number of errors in factfinding.”).

<sup>266</sup> Schroeder uses the example of a speeding driver to illustrate how the administrative costs would make most increased risk scenarios impossible for private enforcement. Schroeder, *supra* note 26, at 473-74.

<sup>267</sup> See Rosenberg, *supra* note 10, at 908-10 (proposing a “public law” approach).

risk in the aggregate is great on society as a whole. Private enforcement is impractical for two reasons: (1) the transaction costs of litigation far outweigh any harm;<sup>268</sup> and (2) because the harm is so fleeting, quantification of damages would truly be a speculative affair. Thus the harm is redressed through public enforcement. Many criminal and administrative regulations of private conduct are aimed at reducing social costs of behavior that increases risk to society.

Increased risk cases are different because they present prolonged risk exposure in circumstances where the transaction between plaintiff and defendant can be specifically identified and is not consummated for many years. Moreover, the harm is significant and can be quantified.<sup>269</sup> Under these limited circumstances, there is no reason why private enforcement of negligent acts is any more or less efficient than public enforcement since the transaction costs would not be extraordinarily high as compared to the injury.

An argument can also be made that a deviation from the traditional rule could result in a flood of litigation.<sup>270</sup> Any scheme that seeks to award damages proportional to increased risk is said to potentially "open the floodgates" of litigation.<sup>271</sup> However, these policy-oriented reasons are not sufficient bases to justify the traditional rule. The argument overstates the potential for a "flood" of litigation by failing to consider the cost structure of these complex tort cases. Not every situation where there is provable increased risk would result in a lawsuit. These cases are always complex, involving difficult issues of law, fact, medicine, science (and perhaps even financial economics). The costs are prohibitive, and there is significant self-selection involved.<sup>272</sup> Like all rational investors, litigants and attorneys will carefully weigh the costs and

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<sup>268</sup> See generally RONALD COASE, *THE FIRM, THE MARKET AND THE LAW* 95-156 (1988) (reprinting Ronald H. Coase, *The Problem of Social Cost*, 3 J. LAW & ECON. 1 (Oct. 1960) (discussing the nature of transaction costs)). Cf. Guido Calabresi, *Some Thoughts on Risk Distribution and the Law of Torts*, 70 YALE L.J. 499, 533-34 (1961) (the costs of tort liability "should be borne by the activity which causes them," unless the administration of enterprise liability or damages arising out of it prove too costly.).

<sup>269</sup> See *infra* Section VI (discussing the quantification of damages).

<sup>270</sup> See generally Paul J. Komyatte, *Medical Monitoring Damages: An Evolution of Environmental Tort Law*, 23 COLO. LAW. 1533, 1533 (1994) (noting that "eight out of ten Americans live near some type of hazardous waste site.").

<sup>271</sup> See *Metro-North Commuters R.R. Co. v. Buckley*, 521 U.S. 424, 442 (1997) ("[T]ens of millions of individuals may have suffered exposure to substances . . . [a]nd that fact, along with uncertainty as to the amount of liability, could threaten . . . a 'flood' of less important cases . . .").

<sup>272</sup> See *supra* text accompanying notes 226-227 (discussing the litigation selection process).

benefits. For example, if a person has a 10% chance of suffering illness with a present value of \$1 million, the proportionality rule would result in \$100,000 award. Such an award might not even cover the cost of the litigation.<sup>273</sup> Attorneys are incentivized to file a lawsuit only if the potential payout justifies the investment in capital, labor and opportunity cost.<sup>274</sup> Litigation cost is one reason why many of these cases are grouped in class action or consolidated litigation schemes.<sup>275</sup> Because they are expensive to litigate, the liability burden is overstated.<sup>276</sup>

Moreover, the “floodgate” argument *per se* is not a sound basis for creating rules of liability. It is an argument of convenience based on a bias against lawsuits, which necessarily is a bias for defendants. There is nothing inherent in the idea of a lawsuit that should be viewed with disfavor. Whether liability is disproportionately heavy is of course a relative concept. The allocation of liability is always a zero-sum game.<sup>277</sup> The question is whether the rule of law is justified, and whether the bias against lawsuits is based on the premise that most of these cases are frivolous. There is a distinction between meritorious claims, even if the aggregate liability is great, and marginal claims for dubious injuries. Courts are not adverse to imposing high liability in an absolute dollar sense, or liability having severe consequences on defendants.<sup>278</sup> Where there are 1,000 people who have been exposed to significant levels of toxins, can we classify such suits as a flood of litigation? The

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<sup>273</sup> See Michael Saks, *Do We Really Know Anything About the Behavior of the Tort Litigation System—And Why Not?*, 140 U. PA. L. REV. 1147, 1282 (1992) (“[I]t cost society \$1.92 to deliver \$1 of compensation to a victim of negligent injury.”); Gary Schwartz, *The A.L.I. Reporters’ Study*, 15 U. HAW. L. REV. 529, 537 (1993) (estimating that plaintiffs recover only 40-50 percent of total recovery net of litigation costs). Indeed, my own former practice confirms that even relatively simple tort cases, such as insurance bad faith litigation, can well exceed \$100,000 in fees and costs if the matter is vigorously defended and proceeds to trial.

<sup>274</sup> This is particularly so in tort law because of the American rule of attorneys’ fees. See *Alyeska Pipeline Service Co. v. Wilderness Society*, 421 U.S. 240, 246 (1975) (prevailing party cannot recover attorneys’ fees unless mandated by statute or contract).

<sup>275</sup> See, e.g., *Anderson v. W.R. Grace Co.*, 628 F. Supp. 1219, 1232 (D. Mass. 1986) (consolidated action of 33 plaintiffs).

<sup>276</sup> See Schroeder, *supra* note 26, at 473-75.

<sup>277</sup> See *supra* note 222.

<sup>278</sup> See, e.g., Cheryl Block, *Liquidations Before and After Repeal of General Utilities*, 21 HARV. J. LEG. 307, 334 (1984) (liquidation is death of corporation); Francis E. McGovern, *The Tragedy of the Asbestos Commons*, 88 VA. L. REV. 1721, 1725 (2002) (estimating \$54 billion in liabilities incurred for asbestos, and another \$200 to \$265 billion more in the future (citing STEPHEN J. CARROLL ET AL., RAND INSTITUTE FOR SOCIAL JUSTICE, ASBESTOS LITIGATION COSTS AND COMPENSATION: AN INTERIM REPORT 53, 77 (2002))).

answer is not self-evident, and it depends on whether these people had a valid interest violated for which there is a cognizable injury.

## V. FREEDOM FROM RISK AS A LEGAL INTEREST

### A. *Defining Interest and Harm*

The question then is: Why should freedom from increased risk be a legally protected interest? The Restatement provides the basic framework for discussion. Under traditional negligence law, a plaintiff must prove that a breach of a duty caused injury.<sup>279</sup> A breach of duty is the violation of a legally protected interest.<sup>280</sup> The Restatement defines an injury as "the invasion of any legally protected interest of another."<sup>281</sup> This notion is separate from a harm, which is defined as "the existence of loss or detriment in fact of any kind to a person."<sup>282</sup> Harm differs from injury in that it is not necessarily the product of an invasion of a legally protected interest, though most injuries are the infliction of some harm.<sup>283</sup>

Under traditional tort law, harm is generally considered to be "bodily harm, physical harm, pecuniary harm, and the like."<sup>284</sup> The traditional rule forces an increased risk analysis into the law's inadequate conceptualization of the injury troika. Increased risk defies easy categorization.<sup>285</sup> On the one hand, an accident precipitates the cause of action and increased risk clearly involves the prospect of physical harm and economic loss. The potential economic loss component has a property-like interest if we perceive a person's economic potential as a capital asset. On the other hand, the harm created by increased risk is informational in nature. Risk is fundamentally the concept of information and the lack thereof, and specific information on the level of uncertainty determines in part value in the market. The law too recognizes the value of information in a number of areas,<sup>286</sup> including invasion of privacy and defa-

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<sup>279</sup> RESTATEMENT (SECOND) OF TORTS § 328A (1965).

<sup>280</sup> *Id.* § 4. An interest is legally protected if society recognizes a desire to protect that interest through the imposition of civil liability. *Id.* § 1, cmt. d.

<sup>281</sup> *Id.* § 7(1).

<sup>282</sup> *Id.* § 7(2).

<sup>283</sup> *Id.* § 7(1), cmt. a.

<sup>284</sup> *Id.* § 7, cmt. b.

<sup>285</sup> Some scholars have suggested that increased risk is sufficient to create liability, though the harm is less apparent than a physical injury. See *supra* note 33. Also, the law has recognized liability where there is physical injury but not a showing of causation in fact. See *infra* Section V.E (discussing the market share theory of liability).

<sup>286</sup> For example, the law protects intellectual property rights, 35 U.S.C. §§ 100-318 (2004) (Patent Act); regulates the disclosure of private information by financial institu-

mation, both of which involve a disruption of the person's informational integrity.<sup>287</sup>

This article started with the proposition that risk has inherent value, and it cited among other things the example of a lottery ticket.<sup>288</sup> We return to the lottery example here. Consider what would happen if a lottery ticket is tortiously converted. Everyone loves a winner, and not surprisingly there have been a number of cases for conversion of a winning lottery ticket.<sup>289</sup> But what if a person steals a lottery ticket that eventually proves to be a loser?<sup>290</sup> Even though *ex post* the plaintiff did not have anything of value, the law would clearly provide a remedy for conversion with damage calculated as the value of the ticket at the time of the theft.<sup>291</sup> This is of course the correct result. The defendant took something of value at the time of conversion and should not escape liability just because luck subsequently diminishes the chattel's value to nil. But beneath this clarity of result, we need to identify why the law would provide a remedy. This inquiry touches on the notion of property. Is the lottery ticket tangible property? We assume it is. It is physical in form, it is sold on every street corner, and it has trading value (at least *ex ante*). At first glance, the ticket squarely falls within the law's framework of the injury troika. But what if it

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tions, 15 U.S.C. §§ 6801-09 (Gramm-Leach-Bliley Act); and imposes evidentiary prohibitions in rape cases, FED. R. EVID. 412.

<sup>287</sup> Invasion of privacy is based on a fundamental right "to be let alone." Warren & Brandeis, *supra* note 3, at 195 (quoting T. COOLEY, A TREATISE ON THE LAW OF TORTS 29 (2d ed. 1888)). See also William Prosser, *Privacy*, 48 CAL. L. REV. 383, 389 (1960) (synthesizing the right of privacy into four kinds: intrusion into seclusion or solitude, public disclosure of private facts, publicity that places a person in false light, and appropriation of image or likeness).

<sup>288</sup> See *supra* text accompanying notes 116-118.

<sup>289</sup> See, e.g., *Seward v. Dickerson*, 844 So. 2d 1207 (Ala. 2002); *Fitchie v. Yurko*, 570 N.E.2d 892 (Ill. App. Ct. 1991); *Castilleja v. Camero*, 414 S.W.2d 424 (Tex. 1967).

<sup>290</sup> Research has failed to find such a case, which is not surprising given the amount in controversy. Of course, no one of sound constitution would sue for the theft of a \$1 losing ticket. Nevertheless, the hypothetical is not as academic as it first sounds. In many ways, derivatives are like lottery tickets in that they are pure bets on the value movement of an underlying asset. Like a lottery ticket, a derivative will either hit or miss. Therefore, there is the possibility of a lawsuit brought for the conversion of a large stake in a derivatives position, which eventually proves to be "out of the money" at maturity. Currently, I am unaware of any such dispute, but it seems only a matter of time before the ownership of a derivative position is disputed.

<sup>291</sup> See DOBBS, *supra* note 91, § 5.13(2), at 547 ("The general rule requires the courts to assess market value of a damages, destroyed or converted chattel at the time of the harm."). There could be an issue of whether market value would be the expected value of the lottery ticket or the market price of the lottery ticket. *Id.* at 546 ("If it is taken or destroyed, the plaintiff may be allowed to recover the reasonable costs of replacing the item.").



does not take physical form but ownership is recorded in electronic format or someone's memory? This fact does not change the legal result because the physical ticket itself, as with a stock certificate or a property deed, has no inherent value. The true asset is the thing that ticket, certificate or deed represents. The notion of property is abstract,<sup>292</sup> leading to the question: What exactly has been converted? We could say it is the original \$1 investment in the ticket. But the original investment was the consideration to purchase the ticket and is different from what was actually given to the plaintiff and converted.<sup>293</sup> The thing converted is not property at all, in the sense of a tangible chattel or money. It is the opportunity for gain, an abstraction but property nonetheless. The risk taken by the ticket purchaser has inherent value that must be compensated when that chance was tortiously converted. The *ex ante* chance (the risk) is independent of the *ex post* win/loss result (the money reward).

Keeping this framework in mind, suppose that each person's economic value or health status is calculated and recorded in a certificate. These certificates are then traded in an open market, used as collateral for debt, sold as garnishment of future wages, and insured against diminution of value. Further, their value can be speculated on through derivative instruments also traded on the market.<sup>294</sup> If a defendant steals this certificate, would he be liable for conversion? What if he changes the essential nature or character of this "property" so that the value of that certificate decreases in the market? Would he be liable for this decrease in value

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<sup>292</sup> HERNANDO DE SOTO, *THE MYSTERY OF CAPITAL* 42-43 (2000). "Capital is born by representing in writing—in a title, a security, a contract, and in other such records—the most economically and socially useful qualities *about* the asset as opposed to the visually more striking aspects of the asset." *Id.* at 49-50. See *Kremen v. Cohen*, 337 F.3d 1024, 1030 (9th Cir. 2003) (in a dispute over the ownership of an internet domain address, court set forth a three part test to determine whether something can be classified as property: (1) interest capable of precise definition, (2) capable of exclusive possession or control, (3) viability of a legitimate claim to exclusivity).

<sup>293</sup> If this was not the case, then the remedy for the conversion of a winning lottery ticket should be the original \$1 rather than the winnings. Of course, this result would never stand as a matter of legal and equitable remedies.

<sup>294</sup> These assumptions are not as far-fetched as they may seem. Life insurance certainly underwrites the economic value of life. Scholars and the financial communities are continuing to expand the uses of financial engineering in bold and imaginative ways. For instance, Shiller recognizes that one's livelihood, income potential and susceptibility to inequity should be protected through financial engineering. ROBERT J. SHILLER, *THE NEW FINANCIAL ORDER: RISK IN THE 21ST CENTURY* 4-5, 107-64 (Princeton Univ. 2003). Moreover, he proposes the commoditization of these financial instruments and the development of trading markets, which would have a profound impact on our lives and our understanding of risk management. *Id.* at 189-230.

regardless of whether ex post the risk manifests? Is it possible to view a person's prospective economic value as a capital asset akin to property? In theory, at least, the decrease in a person's economic value could be the basis to recognize a legal injury.

Until the nature of the harm caused by increased risk is clearly identified, the argument for recognizing increased risk as a protected interest is diminished, notwithstanding the fairness and policy arguments.<sup>295</sup> The following sections explain how a plaintiff has been harmed. Some aspects of harm fit nicely into the traditional understanding of legal injury, but others are less tangible though no less real. To explain the latter, this article analogizes a victim's situation to financial securities. This analogy serves both to demonstrate the nature of the harm and to quantify that harm. Such an analogy might draw objections from some as there are natural limitations: a firm is an economic entity existing primarily to generate profits for its investors, whereas profits are not the primary basis for the existence of a person; so equating a person to a firm may be viewed as dehumanizing the inherent value of a human being. The point is well taken. But it cannot be denied that a significant part of any person's constitution is an economic component. We see this in compensation for wrongful death, which treats a decedent's value from a substantially economic perspective. There are also costs precipitated by increased risk to both firms and persons, and one purpose of tort law is to remedy the costs imposed on victims. The financial analogy is appropriate to understand how involuntarily subjecting a person to increased risk imposes costs to the victim, decreases her "asset" value, and creates an option scenario that has only negative value.

### *B. Increased Risk as a Cost*

An injury can be in the nature of imposed costs. Personal injury, property damage and pecuniary loss all concern costs imposed on a victim. The most accessible concept of cost usually connotes out-of-pocket economic losses.<sup>296</sup> Cost, however, has a broader meaning. In finance, cost measures the price paid as set by the risk, and it makes no difference whether this price is paid in money or barter (a tangible cost) or in lost valuation or opportunity (a more abstract notion). Increased risk imposes both kinds of costs on the victim.

<sup>295</sup> See *supra* notes 24-29.

<sup>296</sup> See RESTATEMENT (SECOND) OF TORTS § 924 (1965).

With respect to economic costs, increased risk cases involve the cost of future medical monitoring, which courts have carved out as an independent cause of action.<sup>297</sup> There is also another pecuniary cost: if exposed plaintiffs are honest in their dealings with insurance companies, they can expect to pay higher insurance premiums as a result of their increased susceptibility to future physical injury.<sup>298</sup> Exposure to toxins is a relevant, unobjectionable factor in the consideration of life or health insurance premiums, and we would expect that an exposed plaintiff would incur additional economic costs for insurance. Thus, recovery for increased risk can be seen in part as the payment of the victim's insurance costs.<sup>299</sup>

Increased risk also imposes nonpecuniary costs. It is unquestionable that a victim would suffer from mental disturbance and decreased quality of life. Courts have recognized some of these costs by allowing fear of disease and mental distress causes of actions.<sup>300</sup> Thus some aspects of these nonpecuniary costs also fit squarely into the traditional legal framework.

Increased risk also imposes opportunity costs. Every choice (option) creates an opportunity cost, defined as the expected return on a project foregone.<sup>301</sup> In industry and finance, opportunity cost analysis is performed regularly to determine whether a firm is maximizing the efficiency of its capital allocations. If the

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<sup>297</sup> See *supra* note 163.

<sup>298</sup> The insurance industry routinely calculates the cost and risk of poor health in calculating premiums for life and health insurance, and annuities. Michael I. Krauss & Robert A. Levy, *Calculating Tort Damages for Lost Future Earnings: The Puzzles of Tax, Inflation and Risk*, 31 GONZ. L. REV. 325, 353-54 (1995-96) (discussing pricing of insurance premiums). Indeed, voluntary exposure to toxins (such as cigarette smoking and alcohol consumption) and prior history of susceptibility to disease are relevant and legal considerations in the determination of premiums. When an insurance company issues a life insurance policy, that policy is an assessment of the underlying risk (i.e., the risk of premature death). See generally FLOYD S. HARPER & LEWIS C. WORKMAN, *FUNDAMENTAL MATHEMATICS OF LIFE INSURANCE* (1970).

<sup>299</sup> See David Rosenberg, *Individual Justice and Collectivizing Risk-Based Claims in Mass-Exposure Cases*, 71 N.Y.U. L. REV. 210, 219 (1996) (damages should equal "the premium that would purchase an insurance policy providing tort-type and tort-level damages in the event that the ultimate accrued harm occurs"); FRANK CROSS, *ENVIRONMENTALLY INDUCED CANCER AND THE LAW: RISKS, REGULATION AND VICTIM COMPENSATION* 210 (1989) (damages should equal "the present cost of adequately insuring against probable future costs associated with the particular risk."). Other commentators have reasoned that damages are justified by increased insurance costs. See Ashton, *supra* note 29, at 1122; Brent Carson, Comment, *Increased Risk of Disease from Hazardous Waste: Proposal for Judicial Relief*, 60 WASH. L. REV. 635, 650 (1985); Note, *Latent Harms and Risk-Based Damages*, 111 HARV. L. REV. 1505, 1520 (1998).

<sup>300</sup> See *supra* note 162.

<sup>301</sup> BREALEY & MYERS, *supra* note 46, at 97-98.

opportunity cost is greater than the yield on the current project, a firm's capital allocation is said to be inefficient, creating a cost to the firm even though the project may be profitable from the perspective of a pure accounting return.<sup>302</sup> If the opportunity cost is less than the current yield, then a firm has efficiently used its capital. Similarly, individuals regularly conduct less formal opportunity cost analyses when, for example, they relinquish a job to be closer to family or choose not to pursue a lawsuit because the emotional toll outweighs the potential economic reward. Opportunity cost is a weighing of the value of the two options, and finance theory suggests that it should be considered when deciding on a particular course of action.<sup>303</sup>

For an exposed individual, the opportunity of an otherwise healthy future is lost. It is a surprising anomaly in the law that many jurisdictions recognize opportunity cost in the loss of chance doctrine but not in increased risk cases. The two theories are mirror images from a risk perspective. The common explanation for this anomaly is that loss of chance involves medical malpractice and the special policy of holding medical professionals to a higher standard.<sup>304</sup> While this may be true, another factor may be at work here: the loss of chance doctrine is a judicial recognition of the ordinary concept of opportunity cost.<sup>305</sup> There is an opportunity cost for society as well. Even a 1% increased risk of death in a class of 100 victims means that one more person will likely die. The loss of each unique individual is not only an enormous loss to those related to her, but also to society.

Lastly, there are the costs associated with extraordinary litigation process risk. Recall that increased risk presents significant problems dealing with statutes of limitations, the single claim rule, stale or lost evidence, and the potential disappearance of defend-

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<sup>302</sup> "If the ROIC [return on invested capital] is greater than zero but less than its weighted average cost of capital (WACC) the company may be 'profitable' but it will not provide an adequate return to the suppliers of capital. From this perspective, the company is destroying value." COPELAND ET AL., *supra* note 57, at 27.

<sup>303</sup> See BREALEY & MYERS, *supra* note 46, at 97-98.

<sup>304</sup> See *supra* note 174 and accompanying text.

<sup>305</sup> See, e.g., *Delaney v. Cade*, 873 P.2d 175, 182 (Kan. 1994) ("[T]he loss of chance doctrine serves to fairly compensate the plaintiff for the tortious deprivation of an opportunity to live longer and recover from a physical injury or condition inflicted by the defendant's wrongful act or omission." (emphasis removed) (quoting Darrell L. Keith, *Loss of Chance: A Modern Proportional Approach to Damages in Texas*, 44 BAYLOR L. REV. 759, 760 (1992))).

ants.<sup>306</sup> These risks are present for most ordinary torts as well, but they are greatly magnified by the latency period of increased risk tort situations. Although plaintiffs are not at fault, they bear the costs of these increased litigation process risks. Under the circumstances, it must be asked whether the innocent plaintiff or the culpable defendant should bear the cost.

### C. *Increased Risk as a Diminution of Asset Value*

Increased risk diminishes an individual's economic asset value. Although each person has an inherent worth that is incalculable in monetary terms, a part of this worth is a certain economic value that can be readily calculable. This economic value is a part of the human capital asset, which is evaluated and bartered for in typical credit transactions such as loans and mortgages. In wrongful death cases, the law values this component of a person and remedies the loss. Viewed this way, the law implicitly analogizes a person to a firm in that both are economic assets anticipated to throw off a future stream of earnings.<sup>307</sup> As demonstrated by CAPM and the DCF, the theoretical stock value of any firm depends on the projected cash flows and the risks associated with them.<sup>308</sup> This valuation concept is incorporated in the pecuniary loss method of valuing damages for loss of life.

Increased risk decreases the pure economic value of a person's life. The CAPM shows that risk is a key component in calculating a firm's value. Like firms, all persons have a certain risk premium, as evinced by actuarial tables used by insurance companies.<sup>309</sup> An

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<sup>306</sup> Schroeder, *supra* note 26, at 475-76 (noting the unreliability of a causation-based system for torts with long latency periods).

<sup>307</sup> I do not equate the true value of human life to an economic asset. The intrinsic value of human life is worth more than an economic stream of earnings. See Joseph A. Kuiper, *The Courts, Daubert, and Willingness-to-Pay: The Doubtful Future of Hedonic Damages Testimony Under the Federal Rules of Evidence*, 1996 U. ILL. L. REV. 1197, 1202-03 & nn. 38-40 (1996) ("Much of this criticism focuses on the failure of pecuniary losses to account for life's intrinsic value."). Remedying a lost life with money is an inadequate solution, though it is the best worldly solution available.

<sup>308</sup> See Krauss & Levy, *supra* note 298, at 348-53 (discussing the role of risk and the CAPM on calculating damages under the pecuniary loss method.).

<sup>309</sup> Insurance companies value the risks and price their products so that premiums exceed the value of the risks assumed. They routinely measure this concept by a combined ratio, which is the ratio of losses plus operating expenses to premiums earned. In the simplest sense, an insurance company turns a profit so long as: (Losses Incurred) + (Operating Expenses) < (Premiums Earned) + (Investment Earnings from Premiums Paid). See SMITH, *supra* note 41, at 125 ("In order to make insurance, either from fire or sea-risk, a trade at all, the common premium must be sufficient to compensate the common losses, to pay the expense of management, and to afford such a profit as might have been drawn

example illustrates the concept. Assume for simplicity two individuals with the same age, life expectancy of ten years and net earnings of \$100 per year, growing at a compounded rate of 7% per year. Assume also that one person has a 20% chance of death within the life expectancy due to exposure to toxins, and expert testimony establishes that the overall risk distribution, or risk density as denoted  $R_d$ , in years 1 through 10 is as follows: 0.2%, 0.3%, 0.8%, 1.8%, 3.7%, 6.4%, 4.6%, 1.4%, 0.6%, and 0.2%. An economist is charged with calculating both persons' economic value, and sets the baseline discount rate at 10%, which reflects the anticipated inflation rate and the inherent risks of these cash flows without consideration of any special risk factors like exposure to toxins.<sup>310</sup> (These assumptions are referred to as the *Standard Assumptions*, and they will be used as a standard set of data in Section VI of this article to illustrate the different methodologies available to calculate damages.)

Under these simple facts, the economic value of these individuals would differ significantly. For the unaffected individual, the present value of the economic asset would be \$805.<sup>311</sup> For the affected individual, the economist must factor the increased risk into the discount rate.<sup>312</sup> Each cash flow should be discounted by the baseline rate plus the increased risk attributable to that year. The calculation then yields an economic asset value of \$731.<sup>313</sup> This shows that increased risk adversely affects a person's economic asset value.

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from an equal capital employed in any common trade.”); Letter from Chairman Warren E. Buffett to Shareholders of Berkshire Hathaway, Inc. 6 (Feb. 28, 2002) (insurance business has value if the cost of float, earned premiums less underwriting losses and expenses, is less than the cost to funds), available at <http://www.berkshirehathaway.com/letters/2001pdf.pdf> (last visited Nov. 20, 2004).

<sup>310</sup> This discount rate would consider the baseline risk to these cash flows (e.g., risk of future unemployment, decrease in earning power or other factors that pose risks to these cash flows) and the anticipated inflation rates. See Richard Posner, *Law and the Theory of Finance: Some Intersections*, 54 GEO. WASH. L. REV. 159, 161 (1986) (future earning streams are not risk free, and therefore should not be discounted based on a risk free rate, but should be discounted by a factor that considers the risks).

<sup>311</sup> The calculation is:

$$\sum_{i=0}^9 \$100 \times (1+7\%)^i \times \frac{1}{(1+10\%)^{(i+1)}}.$$

<sup>312</sup> The concept is precisely the same as the Discounted Cash Flow (DCF) method of firm valuation. See *supra* pages 129-31 (discussing CAPM and equity valuation).

<sup>313</sup> The calculation is:

$$\sum_{i=0}^9 \$100 \times (1+7\%)^i \times \frac{1}{(1+10\%+R_d)^{(i+1)}}.$$

Some may criticize this analysis as mixing apples and oranges. The pecuniary loss method is a theory of remedy that applies only upon the occurrence of a loss event, whereas the concept here is used to advance the argument that there *is* a loss and so liability. When viewed through the traditional legal prism, this criticism is fair. The pecuniary loss method is a theory of remedy that presupposes liability for the injury of death. Even this criticism, however, breaks down under traditional tort doctrine dealing with property loss claims. For instance, suppose a defendant's negligence changes the nature and character of a cherished work of art that has been with a family for many generations; and the adverse change reduced the value of the artwork by \$100, but the owner does not plan to ever sell the painting (so the harm would never be monetized). Of course, the property damage for decreased asset value would still be cognizable. If so, why is there no cause of action for a decrease in value when a defendant's negligence changes the essential nature and character of the person by decreasing her economic asset value? As previously noted, one answer could be that the value of a human being should not be compared to property. But on the flip side, the law has no trouble in valuing human life in wrongful death lawsuits, and one might well query whether *not* providing remedies for diminished asset value marginalizes the uniqueness and importance of our value. Another answer could be that property has a trading market and therefore the interest in property is cognizable. True, there is no formalized market for human beings as there is for works of art or other property. Yet in reality each person is traded in the daily transactions of life. Such trading value is not exclusively based on economic value, but there is no question that economic and health values are consequential factors in our lives. Still another answer could be that calculating a decrease in value is considered inherently speculative. Indeed, one suspects that this is the reason that lies at the heart of the traditional rule.<sup>314</sup> This criticism would be valid, if true, but damages can be calculated under sound financial principles and with a measure of quantitative rigor, while keeping in mind that the law does not arbitrate the correct or incorrect with mathematical precision but instead allocates right and wrong with a sense of fundamental fairness.<sup>315</sup>

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<sup>314</sup> See *supra* note 10.

<sup>315</sup> This is keeping in mind that the nature of these cases, like any other lawsuits, is inherently uncertain. See King, *Causation and Valuation*, *supra* note 25, at 1375 (courts have generally not required "mathematical precision" in providing damages). The law is a

From a financial economics perspective, a decrease in economic value is a tangible harm in and of itself. This decrease in economic asset value is not an abstract notion. Just as stocks are traded in the market, so too each person is assessed and "priced" in the daily transactions of life.<sup>316</sup> This is the case in most everyday economic transactions such as the securing of credit and employment.<sup>317</sup> Again, an insurance transaction illustrates the point in concrete terms. Life and health insurance companies are in the business of assessing each person's "asset" value, and they price the risk to that asset. Any significant exposure to harmful elements will result in an increase in life insurance premiums, which means that the insurer perceives the expected value of that person to be decreased by the increased risk. The fact that businesses and life partners take out life insurance on those on whom they depend confirms that each person has an economic asset value. Life and health clearly are insurable interests and increased risk decreases the value of that interest. Thus there is no reason why the decrease in the economic asset value of a person should not be recoverable.

#### *D. Increased Risk as a Negative Value Option*

Increased risk also presents an option scenario. This option can be likened to a financial derivative instrument because its value is the uncertainty itself. A financial option and an increased risk option are different in two fundamental ways: an increased risk option is not purchased but is involuntarily imposed; and the contingency in an increased risk option always has a negative value.<sup>318</sup> These reasons support the conclusion that, from an option theory perspective, increased risk is a harm and should be a legally cognizable injury.

Option theory can be used to analyze the increased risk problem and calculate damages. There are several considerations here. First, an option always has value until expiration. In this case, the

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social science, and it cannot be explained in neat, absolute equations. Nor is it appropriate to overly rely on precise mathematics to explain what are essentially human interactions. See Laurence Tribe, *Trial by Mathematics: Precision and Ritual in the Legal Process*, 84 HARV. L. REV. 1329 (1971) (explaining the limits of relying on mathematical precision to decide cases).

<sup>316</sup> Scholars have recognized that livelihood and educational value constitute significant economic asset values that require protection by the law or financial markets. See generally SHILLER, *supra* note 294.

<sup>317</sup> See *supra* Section II.B (discussing credit transactions).

<sup>318</sup> If a financial option is far "out of the money," its value could be almost worthless. Nevertheless, until expiration, an option theoretically always has positive value.



value is always negative. Second, option value is calculated by considering, among other things, the dynamic nature of time and risk.<sup>319</sup> Third, options can be exercised before expiration. In increased risk cases, the victim has a choice between waiting for a manifestation of injury, assuming no time bar due to statute of limitations, and suing now for increased risk damages.<sup>320</sup> Robinson emphasized this multiple optionality:

I do not propose to *require* victims to pursue recovery for risk if they prefer to await the outcome and seek compensation for actual injury. The question is whether there is reason to deny an action to a risk victim who does not want to wait, say, a decade to find out whether injury ensues.<sup>321</sup>

Of course, the choices are mutually exclusive: if a plaintiff sues for an increased risk injury, she cannot later sue for a physical injury upon manifestation. An option represents a choice, and once the choice is made, it cannot be undone.<sup>322</sup>

### *E. Causation Revisited*

The problem of causation has been the Gordian knot in this field, and so we return to the issue again. Because increased risk cases lead to an aggregate under-compensation of plaintiffs and under-deterrence of wrongful conduct, some courts have relaxed the evidentiary burden of the causation element.<sup>323</sup> Some scholars have cautioned that such ad hoc "tinkering" could lead to significant confusion,<sup>324</sup> while others have proposed eliminating the causation element altogether to serve moral justice.<sup>325</sup> The elimination of causation would certainly brush aside the apparent

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<sup>319</sup> See *supra* Section II.D; *infra* Section VI.B.

<sup>320</sup> See *supra* text accompanying notes 150-151 (discussing statutes of limitations); *infra* Section VII.B (proposing that the statute of limitations be abolished in increased risk cases).

<sup>321</sup> Robinson, *supra* note 25, at 788.

<sup>322</sup> A purchaser of a call option cannot prematurely exercise an option and then seek additional compensation if the stock price subsequently rises. The common law incorporates this concept. In the situation above, courts would apply the principle of *res judicata* to bar plaintiff from suing again. Courts may even extend the principle of assumption of risk, which allocates risks based on voluntary undertaking to bar such suits. See PROSSER & KEETON, *supra* note 1, § 68, at 480-98.

<sup>323</sup> See, e.g., *Feist v. Sears, Roebuck & Co.*, 517 P.2d 675, 679 (Ore. 1973) (susceptibility to meningitis, though not probable and no more than a possibility, was admissible evidence (relying on *Boyle v. Pennsylvania R.R. Co.*, 170 A.2d 865 (Pa. 1961), and subsequent interpretation by *Schwegel v. Goldberg*, 228 A.2d 405 (Pa. Super. Ct. 1967))).

<sup>324</sup> King, *supra* note 24, at 1370.

<sup>325</sup> Berger, *supra* note 9, at 2117.

doctrinal hurdle standing in the way of some form of a proportionality scheme.

While a radical solution, the elimination of causation is not unprecedented, as seen in the development of the market share liability announced in *Sindell v. Abbott Laboratories*.<sup>326</sup> The plaintiff in *Sindell* was injured by exposure to diethylstilbestrol (DES), but could not prove which manufacturer of the drug caused the injuries.<sup>327</sup> Describing the DES cases as “recurring circumstances” where defendants will consistently escape liability on causation grounds,<sup>328</sup> the California Supreme Court allowed recovery based on the proportion of economic benefit each manufacturer received.<sup>329</sup> The court relied heavily on a student written law review article, which explained away the elimination of causation this way: “cause-in-fact results from the fictional presumption that each defendant is the cause because jointly, there is a high probability . . . that the product manufactured by some one of the defendants, all of which behaved tortiously, caused the specific plaintiff’s injury.”<sup>330</sup> In the final analysis, the court concluded “as between an innocent plaintiff and negligent defendants, the latter should bear the cost of the injury.”<sup>331</sup> Once again, the use of legal fiction to bypass traditional tort doctrines is apparent.

This article does not depend on the theoretical considerations of market share liability and so takes no position on its merits.<sup>332</sup> Nor

<sup>326</sup> 607 P.2d 924 (Cal. 1980).

<sup>327</sup> *Id.* at 926. There were approximately 200 drug manufacturers, any one of which could have made the drug that injured the plaintiff. *Id.* at 931.

<sup>328</sup> *Id.* at 936; see also Levmore, *supra* note 221, at 721-26 (suggesting the use of a proportional liability rule for “recurring wrongs”).

<sup>329</sup> *Sindell*, 607 P.2d at 937.

<sup>330</sup> Naomi Sheiner, *DES and a Proposed Theory of Enterprise Liability*, 46 FORDHAM L. REV. 963, 996 (1978).

<sup>331</sup> *Sindell*, 607 P.2d at 936 (citing *Summers v. Tice*, 199 P.2d 1 (Cal. 1948)); see also Sheiner, *supra* note 330, at 1000 (noting that the “basic policy” underlying the theory is “that as between the innocent plaintiff and the tortfeasors, the tortfeasors should bear the cost of the injury”); Gary Schwartz, *The Beginning and the Possible End of the Rise of Modern American Tort Law*, 26 GA. L. REV. 601, 618 (1992) (“The *Sindell* rule achieves the fairness goals of tort law by affording appropriate compensation to the victims of negligence and by imposing liability on defendants in proportion to the harms their negligence has caused.”). *Sindell* has generated an enormous amount of commentary. See, e.g., Glen O. Robinson, *Multiple Causation in Tort Law: Reflections on the DES Cases*, 68 VA. L. REV. 713 (1982); Susan Rose-Ackerman, *Market-Share Allocations in Tort Law: Strengths and Weaknesses*, 19 J. LEG. STUD. 739 (1990); Andrew B. Celli, Note, *Towards a Risk Contribution Approach to Tortfeasor Identification and Multiple Causation Cases*, 65 N.Y.U. L. REV. 635 (1990).

<sup>332</sup> One might question whether such penalties imposed against an entire industry via common law judicial remedy is more appropriately done as a legislative function. Cf. Elli-

does it rely on a theory that would eliminate causation. This statement is only contradictory if the assumed injury is a future physical harm. But if the injury is the increased risk itself, then proof of causation requires a showing that the defendant, and not any other source, imposed (caused) the increased risk. A plaintiff should not be able to recover by showing that a defendant *could* have caused the injury without more, as was the case under *Sindell*. A plaintiff must prove by a preponderance of the evidence that the defendant increased her risk. For liability to be assessed, the risk must be traced back to the defendant under traditional tort principles, constituting a specific transactional nexus between plaintiff and defendant, and only then should the risk be measured for the purposes of awarding damages.

## VI. VALUING DAMAGES

### A. Current Methods

Proof of damages is part of a plaintiff's prima facie negligence case.<sup>333</sup> Increased risk cases should be no different from ordinary negligence actions in terms of proving a prima facie case of breach of duty, causation and damages.<sup>334</sup> If a plaintiff cannot prove damages by legally sound methods, she should not recover even though liability may have been proven. In supporting the traditional rule, courts have reasoned that an award of proportional damages is tantamount to speculative damages. A frequently cited early case is *Ayers v. Township of Jackson*, in which the New Jersey Supreme Court observed, "It is clear that the recognition of an 'enhanced risk' cause of action, particularly when the risk is unquantifiable, would generate substantial litigation that would be difficult to manage or resolve."<sup>335</sup> For obvious reasons, the prospect of speculative damages is a significant issue and the *Ayers* court is correct in that damages must be quantifiable.

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ott, *supra* note 29 (proposing legislative remedial solutions for increased risk liability). With respect to increased risk harms, they are properly within the judicial realm of common law negligence once it is accepted that the law should recognize freedom from increased risk as a protected interest, the violation of which results in injury, and the plaintiff has properly identified the specific tortfeasor who injured her through the provision of proof of causation.

<sup>333</sup> PROSSER & KEETON, *supra* note 1, § 30, at 165.

<sup>334</sup> Under the proposal here, causation would be established by showing that the defendant's conduct caused an increased risk of harm to the plaintiff. This must be shown by a preponderance of the evidence, but the degree of harm is not a relevant issue for causation purposes. Of course, it is highly relevant for damages.

<sup>335</sup> 525 A.2d 287, 307 (N.J. 1987).

In increased risk cases, there are two components of a damage calculation. One is the present value of the anticipated physical injury. The other is the increased risk itself. The former is generally not difficult to determine and is standard fare. Calculating the increased risk is a different story. Increased risk must be shown by scientific evidence.<sup>336</sup> There are various methods of proving the increased risk,<sup>337</sup> and no method is without some uncertainty as to its conclusions. Although scientific evidence may be uncertain and have epistemic limitations,<sup>338</sup> a plaintiff still has the burden of proving damages in increased risk cases.

There are two methods of damage calculation currently in practice. Under the traditional rule, damages are assessed at the full present value of the anticipated future injury. Under the proportionality rule, damages are assessed by multiplying the proportional increase in risk by the present value of the anticipated injury<sup>339</sup>—an approach termed the “single outcome” method.<sup>340</sup> Both methods are two-variable functions, the variables being the risk and present value of total damages. The changing nature of risk as a function of time is not considered.

In addition to these two methods, Joseph King proposed a variant of the proportionality rule. Under his “expected value” method, the increased risk is a fixed value, but the present value of the anticipated injury changes as a function of time.<sup>341</sup> For example, assume that a defendant’s negligence increases a plaintiff’s risk of death by 25%. Death may occur at successive time periods  $T_1$ ,  $T_2$  and  $T_3$ , and the probability of occurrence in each period is 5%,

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<sup>336</sup> By now, calculating damages for personal injuries is standard fare even where the injury is death. Courts have routinely admitted into evidence expert testimony on increased risk even when such risk failed to meet the burden of proof under the traditional rule. See King, *supra* note 24, at 1386 & n.111 (“As a purely technical matter, valuing chance appears to be well within the competency of science.”); *Petriello v. Kalman*, 576 A.2d 474, 484 (Conn. 1990) (actuarial tables of average life expectancy and medical statistics can be used to assist the factfinder in assessing damages).

<sup>337</sup> There are generally four methods to prove increased risk and general causation: structure-activity analysis, in vitro analysis, in vivo analysis and epidemiological analysis. See Berger, *supra* note 9, at 2123-26 (explaining these methods).

<sup>338</sup> See Michael D. Green, *Expert Witnesses and Sufficiency of Evidence in Toxic Substances Litigation*, 86 Nw. U. L. REV. 643, 674-95 (1992) (noting that scientific evidence is subject to numerous uncertainties); Berger, *supra* note 9, at 2129 (same).

<sup>339</sup> See *Petriello*, 576 A.2d at 484; *Dillon v. Evanston Hosp.*, 771 N.E.2d 357, 372 (Ill. 2002); see also Robinson, *supra* note 25, at 787 (stating that damages should equal the “present value of future losses multiplied by the estimated probability of their occurrence”).

<sup>340</sup> King coined this term. King, *supra* note 24, at 1383.

<sup>341</sup> *Id.* at 1384.

15% and 5%, respectively. Assuming that the longer a plaintiff is deprived of life the greater the damages would be, the present value of damages is \$300 for period  $T_1$ , \$200 for period  $T_2$ , and \$100 for period  $T_3$ . Under the expected value approach, the damage is calculated as a weighted average, in this case \$50.<sup>342</sup> King advocates the expected value method because it is more accurate than the single outcome method.<sup>343</sup>

This article proposes that the traditional and proportionality schemes are unsatisfactory and overly simplistic. Both schemes may overcompensate the plaintiff, but for different reasons. The traditional rule may overcompensate a plaintiff because she would recover 100% of any future injury though the probability would range from 51% to 99%. The single outcome and expected value methods fail to consider the lapsing of risk over time, and so both methods calculate the maximum potential payout, resulting in overcompensation where the facts do not warrant such a payout. Additionally, the expected value method is logically inconsistent in that it purports to consider the time series of damages but assesses damages from the fixed time perspective of the beginning term.<sup>344</sup> While both the traditional and proportionality rules benefit from simplicity of calculation, simplicity itself is the source of error because calculating damages based on risk is a fluid rather than a static endeavor.

This article proposes two alternative methods for calculating increased risk damages. The methods focus on the two security instruments involved: one is the negative value option, and the other is the victim's economic asset value. These "securities" are valued differently. Options are valued in the market under the Black-Scholes formula. Under this method, the uncertainty itself is valued. Equity securities are valued under the CAPM and the DCF. Under this method, the victim herself is valued. Both methods are dynamic functions that consider the changing nature of risk, time and value. However, the two methods yield different damages.

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<sup>342</sup> The calculation is:  $(5\% \times \$300) + (15\% \times \$200) + (5\% \times \$100) = \$50$ .

<sup>343</sup> See King, *supra* note 24, at 1384 ("The expected-value method therefore is more consonant with a central purpose of valuing chance: achieving a more rational and accurate loss allocation.").

<sup>344</sup> In other words, the expected value method considers time as a factor, but only in determining the present value of full damages. It does not consider the fact that risk and time are related in addition to time and present value of damages.

## B. Option Pricing Model

We can calculate the option value of increased risk. Although the precise mathematical expression of the Black-Scholes formula is inapposite to a legal discussion, its underlying principles are relevant because analogies can be drawn between the variables that affect the value of a financial option and those that affect an increased risk option. In particular, the notions of strike price, current price, time to maturity and volatility can be imported to a legal setting. Black and Scholes postulated that under certain conditions,<sup>345</sup> “the value of the option will depend only on the price of the stock and time and on variables that are taken to be known constants.”<sup>346</sup> This is the key applicable concept.

The distance between the current stock price and the strike price determines whether the option is in the money or out of the money at any given time.<sup>347</sup> For a call option, if  $S > X + P$ , then the option is in the money. The more  $S$  exceeds  $(X + P)$ , the greater is the profit. The strike price represents the inflection point. We can therefore construct an increased risk option where the strike price is the individual's baseline risk for the particular harm (i.e., the risk of a particular illness or death from natural causes or causes attributable to factors other than the defendant's negligence) and the current stock price is the increased risk.<sup>348</sup> The greater the spread between the individual's baseline risk and the increased risk, the greater is the damage.

Time to maturity is a significant variable. For a financial option, the more time that remains in which it can be exercised, the greater is the opportunity for the option to become in the money (and so

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<sup>345</sup> These assumptions are: (1) short-term interest rate is known and constant, (2) the distribution of stock prices is lognormal, (3) stock pays no dividends, (4) the option is “European” in that it can only be exercised at maturity, (5) there are no transaction costs in buying or selling options, (6) it is possible to borrow fractions of shares, and (7) there are no penalties for short selling. Black & Scholes, *supra* note 68, at 640. These assumptions are largely financial details that have little or no applicability to an increased risk option.

<sup>346</sup> *Id.* at 641.

<sup>347</sup> See *id.* at 638 (“In general, it seems clear that the higher the price of the stock, the greater the value of the [call] option. When the stock price is much greater than the exercise price, the option is almost sure to be exercised.”).

<sup>348</sup> In epidemiology, this concept is expressed as relative risk. See Klein, *supra* note 9, at 1198 n.128. Relative risk is the ratio of risk incurred by the exposed persons ( $R_1$ ) over the risk associated with the general populace ( $R_2$ ). *Id.* If  $R_1/R_2$  is 1.0, then the exposed persons' risk is no greater than that of the non-exposed population. If the relative risk is 2.0, this means that the exposure doubled the risk.

the greater the value).<sup>349</sup> All else being equal, each passing day theoretically decays the value of a financial option. A similar concept works for damage calculation. Just because a plaintiff was once subjected to a 20% risk of disease does not mean that twenty years from now she will still have the same risk if she is symptom free. A plaintiff's risk will decrease on a daily basis, albeit imperceptibly. As a plaintiff survives over the course of time, the nonevent of a physical injury is data relevant to the remaining risk and should also be relevant for damage calculation.<sup>350</sup>

Lastly, a stock's volatility affects option value.<sup>351</sup> The greater the price fluctuates (regardless of direction),<sup>352</sup> the greater are the odds that the current stock price will exceed the strike price. Volatility can be represented by a stock price distribution graph, which typically takes the form of a lognormal distribution.<sup>353</sup> The shape of the curve determines the "density" of the risk. If the curve is tightly banded and the apex is steep, the stock has lower volatility.<sup>354</sup> If the curve is broadly distributed with a lower apex, the stock has higher volatility. Similarly, the pattern of disease manifestation can be graphed over a period of time.

An example better illustrates these points. Using data from the standard assumptions of the earlier discussion,<sup>355</sup> we can graph the probabilities of disease manifestation and the risk density over

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<sup>349</sup> See Black & Scholes, *supra* note 68, at 638 ("On the other hand, if the expiration date is very near, the value of the option will be approximately equal to the stock price minus the exercise price, or zero, if the stock price is less than the exercise price. Normally, the value of an option declines as its maturity date approaches, if the value of the stock does not change.").

<sup>350</sup> Indeed, this is the situation in many cases where the exposure is discovered only after a prolonged period. See, e.g., *Sterling v. Velsicol Chem. Corp.*, 855 F.2d 1188, 1192 (6th Cir. 1988) (disposing ultra-hazardous liquid chemical waste over a ten year period).

<sup>351</sup> See Black & Scholes, *supra* note 68, at 638-39 ("[T]he option will be more volatile than the stock. . . . The relative volatility of the option is not constant, however. It depends on both the stock price and maturity.").

<sup>352</sup> That the direction of the volatility (i.e., the rise or fall of the stock price) is irrelevant to option value was one of the key insights made by Black and Scholes. See *id.* at 642 (noting that "the direction of the change in the equity value is independent of the direction of the change in the stock price"). The intuitive logic is that stocks tending to swing violently downwards also tend to swing similarly upwards, and vice versa. Therefore, volatility is important, irrespective of direction.

<sup>353</sup> A lognormal distribution is the mathematical characterization of a bell curve-type distribution. "A variable has a lognormal distribution if the natural logarithm of the variable is normally distributed." HULL, *supra* note 66, at 228.

<sup>354</sup> Volatility is defined by variance and standard deviation. See BREALEY & MYERS, *supra* note 46, at 132-34 (providing mathematical formulas for determining variance and standard deviation).

<sup>355</sup> See *supra* note 345 and accompanying text.

time. The top broken line represents the probability of disease over time, and the bottom smooth line represents the distribution of risk over time.

FIGURE 3

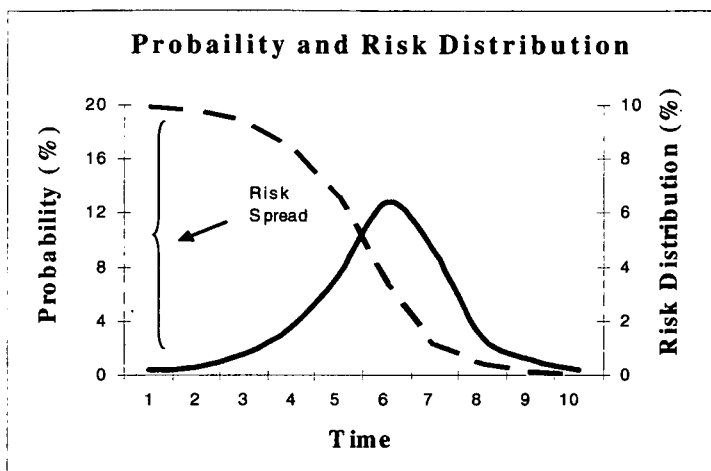


Figure 3 identifies the problem facing courts. The risk spread is the difference between the probability and the known information. It represents the quantified uncertainty. In the beginning, the unknown is the greatest. As time passes, so do portions of the risk. Each day of nonoccurrence is relevant information, and more information diminishes the uncertainty as the risk approaches time to maturity. At the height of the latency period, around the sixth year, if the plaintiff has not yet been injured, the likelihood of a future injury becomes far lower.

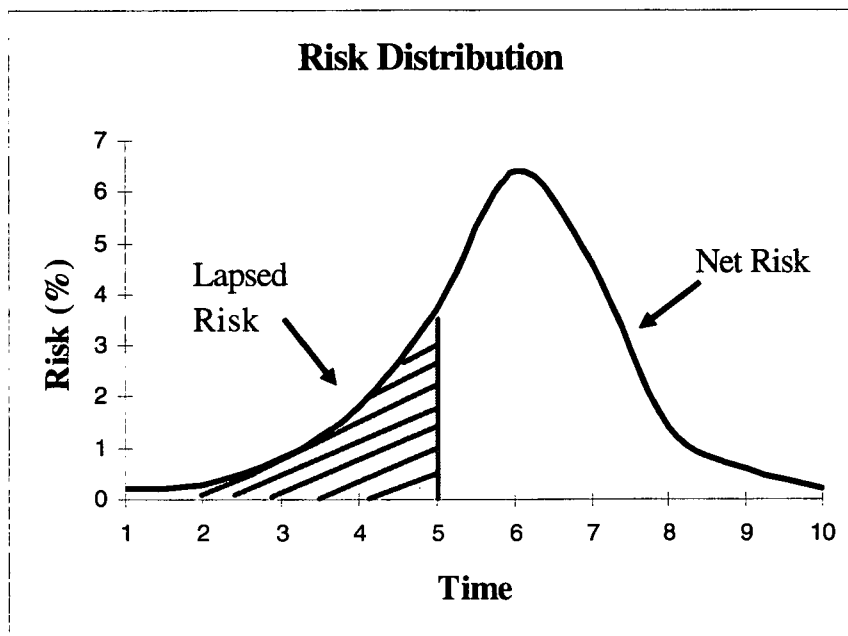
The risk spread is the reason why courts have been hesitant to grant damages—because the unknown is the greatest—and why they have equated the unknown with speculation. But from a finance theory perspective, a significant risk spread means that the harm and so damages are at their greatest. In other words, what the law considers “speculation” is what finance theory considers value. Finance theory suggests that an increased risk cause of action has the greatest value in the early stages of latency, and this is precisely how plaintiffs are injured and why courts need to recognize this injury.

Risk is a function of time. Damages for increased risk should be calculated not as a static, linear number, but as a series of dynamic data points. Its value will depend on the plaintiff's baseline risk,



the increased risk, the latency period and the plaintiff's unique actuarial factors. The baseline risk is a plaintiff's susceptibility to the particular disease absent any negligent conduct. The increased risk is the risk attributable to the defendant's conduct. The actuarial factor is the variable that could intervene to mitigate a defendant's damages, e.g., the chance of accidental or natural death before the disease manifests. Damage calculations must also factor in the time lapsed, because if the odds of disease are distributed in some pattern, then the lapsed time and its associated risk must be discounted. For example, if the plaintiff waits until the fifth year to file a lawsuit, then the lapsed risk must be considered in calculating damages.<sup>356</sup> Figure 4 illustrates this concept using data from the Standard Assumptions.

FIGURE 4



When all of these factors are combined, we can formulate a dynamic option model for calculating damages. We denote  $D_{PV}$  as

<sup>356</sup> The Black-Scholes formula assumes that stock prices are distributed in a lognormal, bell curve distribution. COX & RUBENSTEIN, *supra* note 68, at 201-02. The density of this lognormal distribution describes the probabilities of an array of stock returns. The concept of lapsed risk incorporates the probabilistic nature of risk and time.

the present value of total damages. This number will depend on the unique circumstances of the plaintiff. If the plaintiff is a 10 year old boy who may get cancer in the next ten years, the damages will be different from a similarly exposed plaintiff who is 80 years old.<sup>357</sup> We denote  $R_I$  as increased risk, which is the absolute risk of the injury less the baseline risk;  $R_L$  as the total lapsed risk in percentage terms; and  $A$  as the actuarial factor that should discount the damages to consider the possibilities of an intervening cause.<sup>358</sup> The formula for damages then is:  $D = D_{PV} \times (R_I - R_L) - A$ . This formula is a three variable function, the variables being time, risk and total damages. This method is probably as sophisticated as the damage calculation should be under option principles.<sup>359</sup> The law deals not in the precision of mathematics, but in justice as measured by rationality of process and method.

The application of option pricing principles to damages shows that even the proportionality rule has the potential to overcompensate the plaintiff. If freedom from increased risk is a legal interest, then damages should reflect the negative value of that risk as it changes over time and with other variables. An option model is more accurate than the traditional and proportionality rules.

### C. *Economic Asset Model*

If damages are perceived as the change in the economic asset value of the victim, the damages are simply the difference between the pre- and post-exposure asset values:  $D = EAV_{Pre} - EAV_{Post}$ . These values can be calculated under the DCF valuation principles. The two key components of a DCF analysis are the accuracy of the projected cash flows and the discount rate. The adage "garbage in, garbage out" is as apropos here as it is in calculating the value of IBM. At trial, projections and discount rates are routinely and hotly contested by opposing experts, and increased risk cases would be no different. To calculate the pre-exposure value, the discount rate and projected cash flows are established by an economist. To calculate the post-exposure value, the economist would require data on the increased risk and the risk density.

<sup>357</sup> King recognized these differences in the expected value damage calculation method. See King, *supra* note 24, at 1383-84.

<sup>358</sup> The actuarial factor would be redundant if the discount rate used to calculate the present value of damages factors in actuarial risks. Krauss & Levy, *supra* note 298, at 348; Posner, *supra* note 310, at 161-62.

<sup>359</sup> Efficiency of information and plentitude of data distinguish the financial markets from the legal marketplace. Accordingly, the value of financial options can be calculated by using precise mathematical formulas such as the Black-Scholes formula.

The post-exposure discount rate should be the baseline discount rate plus the increased risk associated with each time period. It is important to note that the aggregate increased risk is not added to the baseline rate for each year. The overall increased risk is spread across the entire latency period per the risk density, and each year's increased risk is a fraction of the overall increased risk. To use this damage calculation method, the scientific evidence must provide a risk distribution across the latency period.

#### D. Comparison of Methods

We can compare the various methods of damage calculation by using the Standard Assumptions. From this simple set of data, we can calculate damages based on the economic asset, option pricing and proportionality methods. These calculations are done for each of the years 1 through 10 so that the differences in the methods are highlighted on a year by year basis.

The first step common to each of these methods is calculating the pre-exposure economic asset value, which can also be seen as the full present value of damages.<sup>360</sup> The asset value is the sum of the present value of all cash flows. The earnings are discounted to present value by the baseline discount rate. As each year expires, the asset value naturally decreases. The calculations produce the following results.<sup>361</sup>

TABLE 1

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Earnings	100.0	107.0	114.5	122.5	131.1	140.3	150.1	160.6	171.8	183.8
Asset Value	805.3	785.8	757.4	718.6	668.0	603.7	523.8	426.1	308.1	167.1

Under the proportionality method, damages are calculated by multiplying the above asset values by the aggregate increased risk.

<sup>360</sup> Each of these methods incorporates King's concept of changing values of damages over time. See King, *supra* note 24, at 1384. For simplicity, the damages are economic and do not include pain and suffering.

<sup>361</sup> The baseline discount rates for years 1 through 10 are: 0.9091, 0.8264, 0.7513, 0.6830, 0.6209, 0.5645, 0.5132, 0.4665, 0.4241, and 0.3855. For convenience, each year after Year 1 represents the future value for that year, and the future values have not been converted to present value at Year 1. This makes sense because the damages depend on which year the plaintiff files suit, and depending on that reference year the damages will differ and cannot be standardized to Year 1 as if the lawsuit was always filed immediately after exposure. Therefore, for each year, the set of discount rates used are the same as those used in years 1 through 10, except that Year 1 "slides over" to Year 2. In other words, in calculating the damages for Year 2, the cash flow for Year 2 is discounted at Year 1's rate of 0.9091 and so forth.

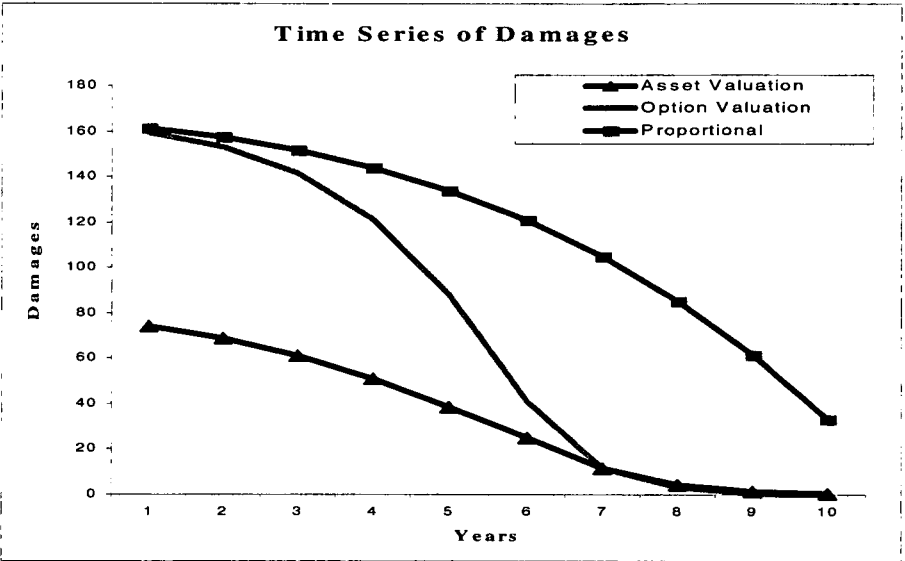
Under the option pricing model, the asset values are multiplied by the net risk. Under the economic asset method, the above asset values are subtracted by the post-exposure asset values.<sup>362</sup> Table 2 summarizes the results of these calculations.

TABLE 2

Damages	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Economic Asset	74.1	68.7	61.1	51.1	38.7	24.8	11.8	4.1	1.4	0.3
Option Pricing	159.4	153.2	141.6	121.4	88.2	41.1	11.5	3.4	0.6	0.0
Proportionality	161.1	157.2	151.5	143.7	133.6	120.7	104.8	85.2	61.6	33.4

A graph of the data set shows the dynamic nature of risk and time and the differences among the damage methodologies.

FIGURE 5



As seen in Figure 5, the greatest damages are in the early years for all three methods. This is consistent with the observations that risk is the actionable harm and the risk spread is greatest in the

<sup>362</sup> Unlike the calculation for pre-exposure asset value, the discount rates are not the same and do not "slide over" on a year by year basis because the unique increased risk is different each year. Each rate is separately calculated based on the particular risk for that year and the number of years out from the reference year. For example, the discount rates that factor in the risk distribution for years 1 through 10 are: 0.9074, 0.8220, 0.7352, 0.6401, 0.5263, 0.4021, 0.3852, 0.4216, 0.4038 and 0.3786 which assume corresponding discount rates of 10.2%, 10.3%, 10.8%, 11.8%, 13.7%, 16.4%, 14.6%, 11.4%, 10.6% and 10.2%.

early years. Under both the option pricing and asset valuation models, the diminution in damages accelerates with time because lapsed risk and time value are factored into the calculation. The asset valuation model produces the lowest valuation because the underlying risk is spread throughout the entire lapsed period, which is then factored into the discount rate. This has the effect of time-adjusting the risk, which results in reduced influence of risk that is further out in time on the present value of damages.

It may surprise some to see that the proportionality rule produces the highest level of damages even though it has been suggested as being fairer than the traditional rule. The higher values are due to the static treatment of risk; damages only decrease with time because the victim's asset value decreases.<sup>363</sup> The proportionality method overcompensates the victims of increased risk because risk is not viewed as a function of time and therefore a fluid analysis. This accounts for the fact that in the early years the option pricing and proportionality methods produce similar results, but as time lapses, there is a widening disparity in valuation.

At this point, it must be asked whether the option pricing and economic asset methods of damage valuation exceed the ability of the plaintiff to produce the necessary data. If the data cannot be produced, the methods are merely academic. Both methods do not require significantly more information than the single outcome and expected value proportionality models for damage calculation. They require data that is one level more detailed than a single probability increased risk: specifically the risk density, or the distribution of risk over time. This additional data requirement, however, is not insurmountable.

Thus far, courts have simply worked with the concept of a single number increased risk.<sup>364</sup> At trial, epidemiological and other scientific evidence may be simplified in terms of a single aggregate probability,<sup>365</sup> a sort of "bottom line" for the factfinder. But all science involves collection and analysis of data. If scientific evidence exists to determine the "bottom line" figure in the first place, then in many cases the underlying data supporting that con-

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<sup>363</sup> See King, *supra* note 24, at 1384.

<sup>364</sup> See, e.g., *Sterling v. Velsicol Chem. Corp.*, 855 F.2d 1188, 1205 (6th Cir. 1988) (25% to 30%); *Petriello v. Kalman*, 576 A.2d 474, 482 (Conn. 1990) (8% to 16%); *Davis v. Gambardella & Son Cheese Corp.*, 161 A.2d 583, 587 (Conn. 1960) (50%); *Dillon v. Evans-ton Hosp.*, 771 N.E.2d 357, 366 (Ill. 2002) (5%).

<sup>365</sup> Based on the available case law, plaintiffs have been able to introduce expert testimony on increased risk. See, e.g., *Sterling*, 855 F.2d at 1205.

clusion would show the underlying properties of that risk, including how that risk is distributed.<sup>366</sup> The damage calculation methods suggested in this article would require evidence that is only one level more detailed than the requirements of the current legal scheme.<sup>367</sup>

## VII. STATUTE OF LIMITATIONS

### A. General Considerations

The concept of a statute of limitations is entrenched in American jurisprudence.<sup>368</sup> With a few exceptions,<sup>369</sup> scholars have not extensively studied statutes of limitations, perhaps because they are so pervasive and accepted.<sup>370</sup> There are three primary justifications for a statute of limitations. First, it provides defendants peace of mind by barring liability for conduct after a specified period.<sup>371</sup> Second, it promotes vigorous investigation and prosecution of claims by plaintiffs, and such investigation advances the interests of justice by securing fresh evidence and facts.<sup>372</sup> Third, it curtails the number of cases filed, and such limitations are said to benefit the legal system.<sup>373</sup>

Statutes of limitations have long been criticized for the arbitrariness of barring an otherwise valid claim on the basis of time

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<sup>366</sup> Like many things, certain diseases are not randomly distributed. For instance, it is commonly known that testicular cancer is most prominent in younger men up to their late 30s, whereas prostate cancer is most prevalent in older and middle aged men. Other diseases exhibit a certain signature.

<sup>367</sup> In producing a single value increased risk, epidemiological data would show other factors such as the distribution of risk across time, geography, race, sex, and other factors. Dore, *supra* note 39, at 432.

<sup>368</sup> Wood v. Carpenter, 101 U.S. 135, 139 (1879) ("Statutes of limitation . . . are found and approved in all systems of enlightened jurisprudence."); Tyler T. Ochoa & Andrew J. Wistrich, *The Puzzling Purposes of Statutes of Limitation*, 28 PAC. L.J. 453, 454 (1996) (statutes of limitations are "ubiquitous").

<sup>369</sup> One commentator has argued that statutes of limitations as applied to toxic tort litigation are fundamentally unfair, and therefore endorses its elimination on constitutional grounds. See Note, *The Fairness and Constitutionality of Statutes of Limitations for Toxic Tort Suits*, 96 HARV. L. REV. 1683 (1983). The article argues that statutes of limitations for claims that necessarily have a long latency period "effectively destroy the only means available for vindicating the victim's constitutionally protected right of personal security." *Id.* at 1702.

<sup>370</sup> See Ochoa & Wistrich, *supra* note 368, at 454 ("With few exceptions, the policies on which limitation of actions is based rarely have been the object of serious study.").

<sup>371</sup> *Id.* at 460-71.

<sup>372</sup> *Id.* at 471-83, 488-92.

<sup>373</sup> *Id.* at 495-500.

lapse.<sup>374</sup> Such a procedural bar conflicts with the strong public policy of resolving claims on the merits.<sup>375</sup> Despite these grumblings, statutes of limitations are firmly planted in the jurisprudential landscape and will not be jettisoned any time soon.

That said, I note a few obvious observations. Statutes of limitations never favor plaintiffs. As discussed, one way to view a lawsuit is as an option, and a statute of limitations puts a maturity date on this option.<sup>376</sup> Whatever tangential benefit plaintiffs may get from being incentivized to prosecute their claims is more than offset by the preclusive effect.<sup>377</sup> As a corollary, statutes of limitations always favor defendants.<sup>378</sup> Since their inception, defendants have sought to apply them as an affirmative defense, and plaintiffs have fought to escape their preclusive effect.<sup>379</sup> These general observations hold true in all fields of law and in all circumstances.

The simple explanation for this effect is that litigation is a two party, zero-sum game. The options are typically simple, and produce polar payoffs where what is good for one is bad for the other. Where, however, multiple options are available to parties, each with its own benefits and costs, this simple calculus no longer holds.

### B. Suboptimality

It is not within the scope of this article to present a broad-based study of statutes of limitations. Rather, this article argues that the statute of limitations should be abolished for increased risk cases on efficiency grounds. If the substantive rules proposed in this article are adopted, the singular situation is created where the application of a statute of limitations presents a suboptimal solution for both plaintiffs and defendants. Under the rules proposed here, a

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<sup>374</sup> Oliver Wendell Holmes once asked: "What is the justification for depriving a man of his rights, a pure evil as far as it goes, in consequence of the lapse of time?" *Id.* at 454 (quoting Oliver W. Holmes, Jr., *The Path of the Law*, 10 HARV. L. REV. 457, 476 (1897)).

<sup>375</sup> Ochoa & Wistrich, *supra* note 368, at 500 (citing *Barrington v. A.H. Robins Co.*, 702 P.2d 563, 566 (Cal. 1985)).

<sup>376</sup> See *supra* note 351 (discussing how time to maturity affects option value).

<sup>377</sup> Under an option analysis, a claim represents an option for plaintiffs. The option is a positive value option because outside of litigation costs (which represent the option premium) the option has only a potentially positive return. A statute of limitations imposes an expiration date on the claim, and as such terminates what is otherwise a positive value option.

<sup>378</sup> As an option, a lawsuit always has positive theoretical value for a plaintiff until the time of judgment for defendant. This does not consider the litigation costs, which can be seen as the option premium.

<sup>379</sup> Rules of civil procedure require that statute of limitations be pleaded as an affirmative defense. See, e.g., FED. R. CIV. P. 8(c).

statute of limitations would have the effect of terminating a plaintiff's option to sue later, which would incentivize more lawsuits and increase costs on defendants and the judicial system. More importantly, a statute of limitations imposes a barrier to informational efficiency for both parties. This informational inefficiency would be unique in the law because it works against the interests of both parties. It is easy to see how eliminating a statute of limitations always benefits plaintiffs, and so this discussion will focus on how defendants benefit from its elimination.

We begin by analyzing the effects of an independent tort for increased risk under a statute of limitations regime. For simplicity, the discovery rule is not at issue because we assume that a plaintiff is immediately aware of the wrongful conduct, suffers some incidental physical effects from the exposure that triggers the statute of limitations, and the choice of filing suit or not is made contemporaneously. Under this scenario, a plaintiff has no practical choice but to sue now for increased risk because failure to do so would preclude both claims for increased risk and the physical injury.<sup>380</sup> The incentive to do so is clearly seen from Figure 5, which shows that the risk spread is the greatest in the early years and significantly decreases after the passage of time. Thus, plaintiffs are incentivized to file suit immediately.

This lawsuit may not be the most economically rewarding outcome given the transaction costs of the litigation. Nor may it be the plaintiff's preference given the noneconomic costs of the litigation, i.e., few litigants enjoy the litigation experience. The following denotes the three potential outcomes where  $C_E$  is the economic transaction cost of litigation,  $C_N$  is the noneconomic cost, and  $D$  is the present value of increased risk damages.

$D > C_E + C_N \rightarrow$  File Suit

$D < C_E + C_N \rightarrow$  No Suit

$D \approx C_E + C_N \rightarrow$  Possibly File Suit

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<sup>380</sup> The discovery rule does not help the plaintiff who is aware of the defendant's wrongful conduct, but whose full injury manifests after the expiration of the limitation period (or symptoms of the full injury manifest within the limitation period though the full injury manifests far later). Under the traditional rule, the plaintiff is caught in a Catch-22 where she must prove the future injury by a preponderance of the evidence or waive the claim because the latency period would in most cases exceed the limitation period. See *supra* notes 150-151 and accompanying text. Therefore, under the proposal here (without the elimination of the statute of limitations and without a mechanism to split the cause of action), the plaintiff's action would essentially be an action for increased risk, and a lawsuit for the future physical injuries would be practically precluded.



We assume that both plaintiffs and their attorneys are rational. We also assume an efficient state where plaintiffs and their attorneys have conducted due diligence and are well informed of the risks of litigation and its potential rewards and costs. If the expected reward outweighs the expected costs, plaintiffs would be incentivized to file suit, and vice versa. When faced with a "use it or lose it" option, the economically rational choice would be to file suit unless the cost of the lawsuit outweighs the potential rewards. Moreover, the noneconomic litigation cost is marginalized by the prospects of losing the potential for all remedies. In a sense, the litigation choice presents the certainty of having the opportunity to pursue a potential remedy at no or little out-of-pocket economic cost in a contingent fee arrangement, whereas foregoing the choice subjects the plaintiff to the uncertainties of her incurred risk. The clear choice is the preference towards certainty. Since the potential damage awards are significant even when the increased risk may be relatively low, many plaintiffs will be incentivized to file suit because something is better than nothing, and the claim preclusive risk of not filing is too great. Under these circumstances, defendants will face a greater probability of defending more lawsuits and the concomitant exposure to both liability and transaction costs.

The increased risk option prevents distortions of the noneconomic cost of litigation and litigation incentives. Consider a legal regime where there is no statute of limitations. Under these circumstances, a plaintiff would not be so quick to file suit. Without a statute of limitations, a plaintiff has two options: a vested option to file suit for increased risk, and an unvested option to file suit for a future physical injury. These options are mutually exclusive, and the selection between them is the dilemma for the plaintiff.<sup>381</sup> Importantly, the primary concern for an average plaintiff would be to receive remedies in the event a physical injury manifests. The costs of harm are greatest (even catastrophic) when physical illness occurs, and since most people are risk adverse to large losses, we understand that many people may prefer to keep the unvested option open even at the cost of relinquishing another option with less potential value. This is not to diminish the harm caused by the increased risk itself; as discussed, the plaintiff has an option to choose a cause of action for increased risk or physical injuries. But clearly, given the choice between remedying

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<sup>381</sup> See *supra* text accompanying note 322.

increased risk or physical harm, a plaintiff would rationally choose the latter. Thus, there may be a benefit to a "wait and see" approach, if the risk of preclusion is removed from the equation. If the plaintiff waits, she will either develop a physical injury or not. If she incurs the physical injury, she can sue and recover the full damages (which is the optimal result from the perspective of remedy). If she does not incur the disease after a prolonged period (which is the truly optimal scenario), she has greater information that she probably will not incur the physical injury at which point a lawsuit for increased risk damages may make no sense.

Thrown into the mix are the option pricing and economic asset methods for damage calculation. Both methods decay the damages with time. The more the plaintiff waits, the greater her incentive becomes to continue to wait and preserve the option to sue for physical injuries. If it looks like she will not incur the physical injury, then she may not mind the loss or diminution of a cause of action for increased risk. The cost barriers to filing suit would surely increase, but the plaintiff would still preserve the right to recover remedies upon the occurrence of a physical injury. Thus, the "wait and see" approach is self-enforcing.

From a defendant's perspective, the longer a plaintiff waits, the better off the defendant will be. Being subject to fewer lawsuits is always a good result for defendants. With the passage of time, there is better information about the future injury and so damages will be diminished. The passage of time also can make the administration of justice more difficult for plaintiffs as extraordinary litigation risk increases. When a plaintiff opts to wait, the cost of this risk is voluntarily assumed, and it increases with the lapse of time. The net result is that there will be fewer lawsuits filed, as many plaintiffs will forego one option for another, which may never vest.

The key factor in these cases is information. It is information, or a lack thereof, that creates the problem in increased risk cases. Greater information benefits both parties, but it can only be achieved with the passage of time.<sup>382</sup> As time lapses, the risk spread narrows as more information becomes known and the risks decrease. The information collected with time is neutral in the sense that it benefits both plaintiffs and defendants, though for different reasons. A legal regime under a statute of limitations does

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<sup>382</sup> This assumes that scientific knowledge will not advance so far that we can predict whether and when a physical injury will manifest. Perhaps someday science can answer these questions, which will moot the concepts of this article and the legal problems it seeks to address.

not allow the parties to capture this information, but rather forces a plaintiff with a potential case to file a lawsuit to preserve her rights, even if her preference is to wait and see rather than file immediately. Eliminating the statute of limitations provides greater information efficiency, which will translate into fewer lawsuits, reduced transaction costs, and superior allocation of remedies to the more costly injuries. Because the substantive rules proposed by this article create multiple options, the unique circumstance in law is seen where a statute of limitations would be suboptimal for plaintiffs, defendants and the judicial system.

### VIII. CONCLUSION

As society progresses and knowledge develops, the law sometimes needs to reassess the interests it protects. This reassessment can be triggered by changing social expectations (as was the case for negligent infliction of emotional distress), greater technological and cultural developments (as was the case for invasion of privacy), or increased knowledge and information regarding particular harms (as should be the case for increased risk torts). The sole purpose for writing this article was to show that increased risk inflicts real harm. This should not be a surprising conclusion because there is a rational price at which victims will pay to be free of increased risk of severe physical injury. This obvious fact alone substantiates the point that risk has value. It also highlights the question of why courts would deny this choice. The law's approach has been to compartmentalize the harm into the distinct categories of injury. Unfortunately, increased risk does not fit neatly into the current tort paradigm of legal interest and injury, and that is the problem. The point of reference has been the injury troika. But describing the harm from increased risk is more complex than the simplistic categories of bodily harm, property damage or economic loss.

This article proposes that there is harm outside of the current injury troika. Increased risk inflicts harm by adversely affecting the integrity of a person's inherent value, or capital asset. The interest that should be protected is the right to her value and freedom from unwarranted imposition of costs (defined in a broader manner than just economic out-of-pocket costs). Viewed through the prism of financial economics, these costs are both tangible and intangible, and some are readily acknowledged by the legal system as independent injuries while others clearly are not. They are the costs of future medical monitoring, the negative impact on the per-

son's quality of life, the increased insurance costs, the extraordinary litigation risks created by uncertainty, the imposition of a negative value option, and the diminution of her economic asset value. Collectively, these harms are too real and great to ignore, and they justify the legal recognition of an interest in freedom from increased risk. Thus the increased risk problem should be one of valuation of damages and not liability.

Because the risk of a future injury is generally categorized in the context of a physical injury, courts and scholars have become bogged down in obtuse discussions of causation and speculative damages that wander the wilderness of legal fiction and epistemology. If, however, increased risk is recognized as a legally protected interest, most of the thorny legal and logical issues are naturally resolved. There is no need to rely on the fiction of a personal injury because the injury is the increased risk itself. There is no need to speculate about the future because the harm is a current one. The Gordian knot of causation is also unraveled neatly and without doing violence to cherished legal doctrines. A plaintiff need only prove that she incurred increased risk, and the defendant caused it. This approach is not only simpler, but is also more faithful to the traditional doctrine requiring proof of breach of duty, causation and injury, each of which is an independent element of a *prima facie* case of negligence.

Finance theory also has application to damage valuation. In theory, the traditional rule could over- or under-compensate victims. In practice, few situations ever give rise to an increased risk meeting the preponderance standard, and so the traditional rule significantly under-compensates victims in the aggregate. This has led many commentators to endorse the more equitable proportionality rule. The proportionality rule is a step in the right direction, but this rule tends to overcompensate victims. By failing to account for risk as a function of time, a concept firmly rooted in financial economics, the rule produces linear results that do not accurately reflect the true damages.

This article suggests that increased risk damages should be calculated by using securities pricing techniques. Both option pricing and economic asset valuation methods consider the dynamic nature of risk. The option pricing model quantifies the underlying uncertainty itself as applied to the plaintiff's situation. The economic asset model calculates the damage to the plaintiff's economic potential, a form of human capital asset, and which is recognized in limited fashion under current legal doctrine. These

methods produce nonlinear damage calculations that reflect the available information, as is done in the financial markets.

Lastly, when increased risk is considered in this light, we see that the imposition of a statute of limitations promotes a suboptimal solution for all concerned. A statute of limitations reduces a plaintiff's options, which is never good for the plaintiff. It also is a barrier to informational efficiency because it prevents plaintiffs and defendants from obtaining more information regarding the increased risk. Informational efficiency better matches liability assessment and remedy allocation, and could reduce the number of lawsuits and the transaction costs associated with them. For this reason, under the proposal here, the statute of limitations should be abolished.